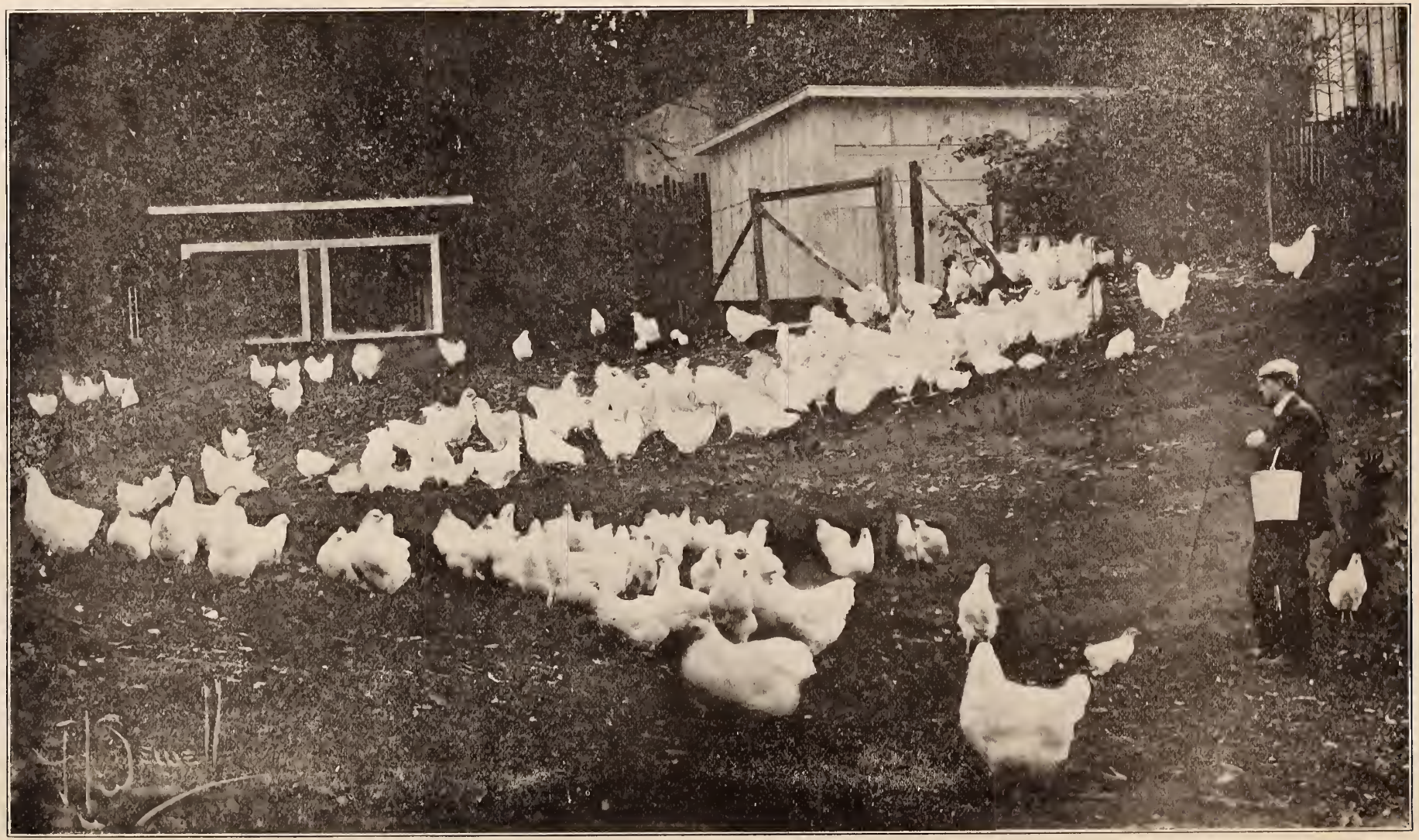

JOHN S. MARTIN, WELL-KNOWN BREEDER OF WHITE WYANDOTTES, FEEDING A FLOCK OF GROWING BIRDS ON RANGE

How To Feed Poultry For Any Purpose With Profit

A Complete and Authoritative Treatise on Feeding All Classes of Poultry — Nutritive Values of Feeds — Formulas to Meet Every Probable Requirement and for Fowls Kept Under All Conditions — Practical Rules for Feeding, and How to Adapt Them to Individual Requirements — A Text Book for the Beginner — A Reference Book for the Expert

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BY JOHN H. ROBINSON

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Economic Conditions Determine Methods—Increased Use of By-Product Feeds Makes Knowledge of the Science of Feeding Useful to Every Poultry Keeper—Nutritive Requirements and Feeding Habits of The Several Kinds of Poultry—Comparison of Digestive Organs of Animals and Birds—Relations of Art and Craft in Poultry Feeding

THE aim of this book is to give a working knowledge of the whole subject of poultry feeds and feeding. The conditions of modern life, and the economic developments in poultry culture, and in other interests directly or indirectly related to it, make some acquaintance with the scientific side of the subject essential. A generation ago, under what we have been accustomed to call natural conditions of life for them, our several kinds of domestic poultry fed themselves, or were fed, almost entirely upon the waste products of farms, and the wastes from the homes and the barns and gardens in the less thickly populated urban districts. What town poultry keepers could not supply their flocks from such sources was made up by purchase of grain from nearby farms.

In the last thirty years all this has been changed The increasing demand for poultry and eggs in cities has led to a great increase in the amount of poultry kept in sections where the farmers have no surplus stock feed to sell. At the same time, the increasing use of prepared cereals for human food made great supplies of by-products suitable for stock feeding. Such by-products consist of the coarser, less palatable, and least nutritious parts of the grains from which they are derived; or of the residue when a particular food element is separated from a certain grain to give a human food having peculiarly desirable properties. The profitable use of such by-products in stock feeding is a question of combining them properly with other feeds and of being able to obtain them at least as cheaply as the feed elements they contain could be bought in the cheapest common whole feed article that might be used for the stock to which they are to be fed.

It follows that the intelligent and economical use of these feeds requires some knowledge of the chemical composition of feed stuffs, and of the scientific principles of feeding. True, the abundance of feeds of this kind has led manufacturers and dealers to give particular attention to the production of commercial mixtures of feed in which these by-products are combined, either with whole feeds or with other by-products, in such proportions that the mixture is equal or superior in value to some common whole feed for which it is offered as a substitute, or perhaps is a complete ration for a specific purpose; but even in using these feeds the poultry keeper needs to know something of their composition and of the properties and values of the ingredients which they contain. He needs this not so much for protection against adulteration of mixtures by unscrupulous manufacturers and dealers, as for insurance against the contingency of being unable to obtain supplies of a feed that he has been accustomed to use, and to enable him to combine to the best advantage the use of good commercial mixtures and feeds obtained from other sources.

The acquaintance with the scientific side of the subject that serves this purpose must be correct as far as it goes, but need not go farther than familiarity with the names and properties of the nutrient elements in feeds, their general relations to the nutritive requirements of animals—particularly poultry—and simple methods of calculating the values of rations. These are in reality matters which under modern conditions are no longer peculiarly scientific but have become a necessary part of practical common knowledge of feeding. For that reason it seems best in a popular discussion of the subject to present the rudiments of the science of feeding as a part of the practical statement of the subject, introducing each in its appropriate place in the general discussion.

I. K. FELCH FEEDING A FLOCK OF HIS LIGHT BRAHMAS

(From a snap-shot by J. H. Robinson, May, 1901)

I. K. Felch, known as "The Father of Poultry Culture in America", was born in Natick, Mass., January 17, 1834, and died there August 31, 1918. From 1846 until his death he was actively interested in poultry culture. The first record of an exhibit of poultry by Mr. Felch, and his first published statement relating to poultry are in the report of the Middlesex South Agricultural Society's Fair at Framingham, Mass., September, 1864, published in "Massachusetts Agriculture, 1864." At this fair he exhibited a cock and four hens, Golden Penciled Hamburgs, which he had imported in 1863, in competition for the premium awarded for best pen of fowls and best statement of their performance for six months preceding the fair. The part of his statement relating to their production reads: "The fowls have been for most of the time enclosed in a yard, three rods long and one rod wide, and their food has been nothing but corn, with fresh water and oyster shells, at an expense of $3.75 for the five fowls for the six months. The four hens have laid in the six months 472 eggs, and one of the hens has been sick ten weeks of the time, being an average of 118 eggs to each hen. But to give each hen her just merits, we should consider that the sick hen only laid about half as many eggs as each of the others. Allowing her to lay 60 eggs would leave 412 to be laid by the three others—being 137 eggs each. One of the hens has in my judgment laid 150 eggs within the past six months. From observations we know that she laid constantly and more than the others."

A MAINE FARM THAT SPECIALIZED IN POULTRY — BREEDING BARRED PLYMOUTH ROCKS TO STANDARD AND FOR EGGS AND MEAT

Here about three or four hundred old birds and from a thousand to twelve hundred chicks had the range of the orchards, pastures, meadows, and some of the cultivated fields—in all about forty acres—and could pick a considerable part of their living at some seasons.

What Poultry Eat

Of poultry in general it may be said that their diet is more like that of man than the diet of other domestic animals. The pig is the only one of the larger animals that is an omnivorous eater, and while the pig will eat meat of any kind when it can get it, it seems much better able to subsist on a vegetable diet than most kinds of poultry. In comparing the natural diets of the most common kinds of poultry we find at the same time such similarity and such adaptability in all, that they may be kept on the same ration, with slight and easily made variations, and yet such differences and such special adaptabilities that one kind may thrive on feed upon which another would be half starved. Their differences in structure and habits of life also enable them to obtain feed under different conditions. The likeness of the several common kinds of poultry in the matter of feeding is of advantage to the poultry keeper when he wishes to keep two or more kinds under intensive conditions. Their unlikeness is of advantage when he wishes to utilize as fully as possible the waste feeds on a large area of land, or large quantities of particular kinds of waste or cheap feed.

The kinds of poultry to be especially considered in a general work on poultry feeding are, — fowls, turkeys, ducks, and geese. The guinea, peafowl, and pheasant require substantially the same feeding as the turkey, and the swan may be considered a large goose. We can, therefore, cover the whole subject thoroughly by treating matters relating to the feeding of fowls, turkeys, ducks, and geese fully, and then making shorter special statements for the other kinds.

Feeding Habits of Fowls

Fowls are the most domestic of poultry. They will forage only as far as is really necessary to get feed. They appear averse to getting so far away from their coop or from cover where they feel safe, that they cannot reach it by a quick dash if danger threatens. So they usually forage over a limited area, working over it thoroughly, but rarely going far in any direction. The ordinary farm flock of fowls, with the chickens that are raised each year, generally take all the poultry feed there is about a farm house, its outbuildings, and the nearby land. That is why so many farms in America have only fowls,—no turkeys, ducks, or geese. Fowls are, on the whole, the most useful and profitable kind of poultry; therefore they take precedence of the others except where particular interest in one of the others results in either limiting the number of fowls kept or making special provision for it beyond the range of the fowls.

A MASSACHUSETTS MARKET POULTRY PLANT IN A LARGE BACK YARD WHERE 1200 TO 2000 WINTER CHICKENS WERE GROWN A YEAR

Here everything consumed by the birds had to be bought for cash. Only nearness to good markets, good work and a good product make poultry growing profitable under such conditions.

Fowls eat almost any tender grass and weeds. They eat all kinds of common grain and most large weed seeds, but little grass seed or small weed seeds. Even small chickens are not at all keen for grass and weed seeds so small that old fowls pass them by. Fowls eat most kinds of insects and worms that are large enough to be readily visible, but seem quite indifferent to the very small insects that attack vegetation. They do not, as far as the writer has observed, eat ants, but they are fond of "ant eggs." They also are fond of nearly all kinds of fruit and vegetables—the only popular article of human food in this line which they do not like being beans.

Feeding Habits of Turkeys

Turkeys are much less domestic by nature than fowls. Being larger, and requiring more feed,—and having also the same reluctance in consuming small bits of nutriment, turkeys range much more widely than fowls. They have not the same attachment for home, and when foraging is poor on their accustomed range they are inclined to wander away, looking for a better feeding ground. This habit makes them especially valuable in the destruction of grasshoppers and other insects which often come in great numbers and move rapidly over large areas. Insects and grain, with some tender vegetation, are their principal diet. They will eat most of the things that fowls eat, but their wanderlust generally leads them to the big pasture fields and woods, leaving the products of gardens and orchards to their less enterprising neighbors.

Feeding Habits of Ducks

Ducks are the most carnivorous of our domestic birds. They are inclined to be as domestic as fowls—provided the dooryard affords them an opportunity to dabble in water. Otherwise they will, if at liberty, seek the nearest water and remain there all day. Nor will they be particular about coming home at night. Their natural feed is the small animal life they find in the water, and especially along the margins of ponds and streams. With this they eat a great deal of coarse and tender green stuff. They probably get little grain in wild life, yet in domestication they can stand a heavy diet of ground grain.

Feeding Habits of Geese

Geese, so like ducks in appearance that people who do not know both well often find it difficult to distinguish between large ducks and small geese, are the most herbivorous of poultry. They can live entirely on grass and similar green forage, with such animal feed as they may get from their range. While they prefer marshy land and access to the water, they will thrive on any good pasture. They like grain, and make their greatest growth when given a liberal grain ration with unstinted green feed. They will go long distances to feed, but almost invariably come home long before nightfall.

A NEW ENGLAND INTENSIVE POULTRY FARM—WHITE BIRCH POULTRY YARDS, BRIDGEWATER, MASS.

The houses for laying-breeding fowls are in the background at the right. The small houses at the left are for breeding ducks. In the middle foreground and center are brooders for young chickens; the colony houses across the rear are for weaned chicks. Small fruit trees may be seen in all yards.

The foregoing general statements of the feeding habits of fowls, turkeys, ducks, and geese show how these different kinds of poultry are adapted to the utilization of feeds which generally are not consumed by or not available to other kinds of farm live stock, and how, while using such wastes, they also do good service in destroying all kinds of insect pests. In all arrangements for poultry on farms, therefore, the first thing considered should be the possible service of poultry in these matters. This is in most cases limited by the necessity for protecting the birds from natural enemies. Yet it usually is possible to do much more in this direction than is commonly done, and it makes the problems of feeding poultry on the farm much easier, and the profits correspondingly greater and more satisfactory.

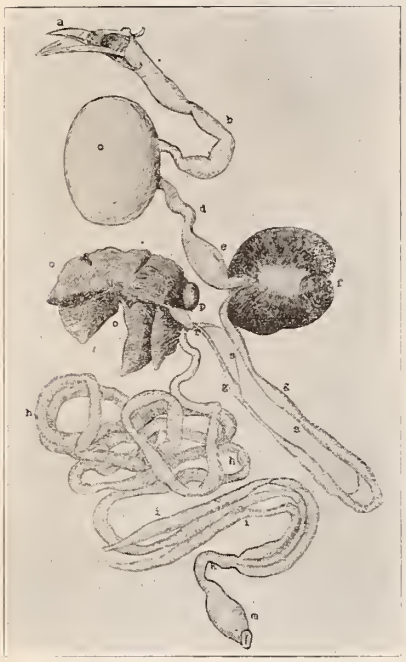
The Digestive Organs of Poultry

There are some things in the feeding of poultry that are better understood if one keeps in mind the resemblances, as well as the differences, in the three types of digestive system which are found in our domestic animals and birds.

The horse masticates its feed thoroughly as it takes it into the mouth; the feed then passes into the stomach, where digestion takes place, and from this into the small intestine where it is assimilated.

In the pig the digestive system and the processes are similar to those in the horse, but mastication is not so thorough. Pigs cannot digest dry fodders and hard grains as fully as horses do, although they have strong teeth and powerful jaws.

In the ruminants—cows and sheep—there are said to be four stomachs, though only the last in the series is properly a stomach. A cow partly masticates her feed as she eats it. When the feed is swallowed it passes into the first stomach or paunch, which is so connected with the second stomach that the contents shift back and forth from one to the other with a churning motion. After a period of this action the feed passes into the third stomach where it forms into balls, which are returned to the mouth for complete mastication. When swallowed this time it passes into the fourth stomach, which is the true stomach, and from there to the intestines.



THE DIGESTIVE ORGANS OF THE FOWL

a, Tongue; (upper bill removed); b, Esophagus; c, Crop; d, Esophagus; e, True Stomach; f, Gizzard; g, Duodenum; h, Small Intestine; i, Caeca; k, Rectum; m, Cloaca; o, Liver; p, Spleen; r, Gall Bladder; s, Pancreas. Courtesy of the New Jersey Experiment Station.

We are accustomed to say that birds have no teeth, but the beaks and bills of birds are to all intents and purposes a combination of incisor and canine teeth. So birds have teeth for biting, cutting and tearing, but not for mastication. The throat is very wide in proportion to the size of the creature, and the gullet capable of great distention. Birds can swallow feed in much larger pieces in proportion to their size, than most other animals can.

The feed swallowed by a bird passes into the crop, which is an enlargement of the gullet. In the land birds, fowls, turkeys, etc., the crop is globular and quite large. In ducks, geese, and other aquatic birds, there is no such distinct development of the crop, but the whole gullet is capable of great distention, and when the birds are able to eat greedily of a bulky feed, this distention of the gullet may be observed the entire length of the neck.

From the crop of a bird the feed passes into the stomach proper, which is a very small organ, and from that to the gizzard—a muscular sac having for its inner surface a thick, tough, corrugated skin. Here it is reduced to a pulp, and in this condition it passes to the intestines. According to traditional popular belief the gizzard itself is not capable of masticating the feed, and—to assist it in that function—the bird swallows bits of gravel or any hard substance that will give a number of sharp cutting edges. Full discussion of that matter is deferred to the appropriate place in the discussion of feeds, but it may be pointed out here that in birds the feed is subjected to the strong action of the gastric juice before going to the gizzard, while in animals which masticate their feed completely in the mouth, the action of the gastric juice comes after mastication.

Nutritive Requirements of Poultry

The body of a bird consists of a framework of bone, to which are attached the muscles that control it; a permanent external covering of skin, in which grows a changeable covering of feathers; and the internal organs of respiration, circulation, digestion, sensation, and reproduction, which are required to sustain the organism and the species. Most of the internal organs are essentially enlargements and peculiar developments of the skin which lines the inside, just as it covers the outside of the body.

Certain facts about the composition of the body are apparent on ordinary observation. We can see that the skeleton contains a great deal of lime, and—in the body of a bird that was in normally good condition when killed—we can see more or less fat. We also see that this fat is in different amounts in different birds, and often in different places. And observing birds that were known to be in health, and perhaps producing well when killed, though not in what we consider prime condition for the table, we naturally and rightly infer that fat is not an essential part of the organism as are the bones, muscles, skin, etc. In extremely fat birds it is easy to see that the excess of fat may both hinder locomotion and interfere with the functions of the internal organs.

The mineral matter of the bones—and the fat, when present, are the only parts of the body of a bird in which we seem to recognize elements of the body in form like that in which they may be seen elesewhere. The rest of the structure appears quite unlike the grains and vegetables which observation showed us make up so large a part of the diet of our domestic birds. For information as to the elements which compose flesh and feathers we turn to the chemist.

Chemistry tells us that flesh, skin, etc. of birds are made of nitrogenous material to which is given the general name protein. The chemical analysis of poultry meat finds in it principally water, protein, and fat. The substance of all fleshy tissues is formed from protein, and it is customary to consider the fat found in them as not an essential part of their structure. This, however, is a too-narrow view, overlooking the function of the fat, or oil, in various parts of the body in keeping it in good order. Even the bones contain fat. Of the chemistry of feathers we know little, for they have no feed value, and chemical investigation in this line has so far been almost entirely devoted to the things that are used to feed either men or animals. It would appear, however, that they contain a considerable proportion of protein.

The analysis of meat does not show the presence of

carbonaceous elements other than fat,—except in very small quantities in the liver. This absence of the starches and sugars from the dead body does not mean that they are not highly essential to the nourishment of the living body. All that it signifies is that they are not stored in the body in the form in which they are taken into it. That poultry need such feeds, and in large quantities, is plain, for they consume them, and generally prefer what the feeder considers a too-carbonaceous ration to a more nitrogenous one. The reason for this is apparent when we consider that what an animal eats not only builds up and keeps in repair its body, and provides material for a product, such as milk or eggs, but must first keep up the heat of the body and provide the energy required for every motion and function.

LOW-LYING PASTURE LANDS AND THEIR PONDS AND BROOKS ARE IDEAL FOR DUCKS AND GEESE.
Scene on Brook View Farm, West Newbury, Mass.

In the requirements for the growth and maintenance of their bodies, poultry are like animals, but in the requirements for reproduction another element comes in. For the shells of their eggs they need much more lime than is contained in any vegetable or flesh feed. This they evidently obtain in a state of nature by eating small bits of stone, shell, etc., that will supply it. In domestication, with egg production extended through much longer seasons, and with birds kept so long on the same areas that all material of this kind at or near the surface has been consumed, it becomes necessary to supply shell-making material liberally.

Art and Craft in Poultry Feeding

For reasons which will appear as the subject is developed in succeeding chapters, the feeding of poultry could not be reduced to an accurate science, even if all poultry of the same kind had precisely the same taste and capacity for digesting and assimilating feed. It would still be necessary for the feeder to rely upon his judgment in many circumstances, and to be governed largely by temperature in his endeavors to make each day's rations meet the needs of the birds. But poultry of all kinds are much like human beings in their tastes and in their likes and dislikes for particular things.

The common feed elements they require can be provided in many different combinations. Birds accustomed to a particular combination are often so reluctant to take another that they will eat of it only enough to maintain them, but not enough to give their best growth or production. We cannot say that this is always purely taste or whim—something that they should be forced to overcome, and will overcome if they can get nothing else. Birds brought up on a certain diet have their digestive systems especially adapted to it, perhaps to such an extent that they are poorly adapted to some other diet which may be given them. To force them to a diet they apparently do not relish is not good policy, unless it is known to be a good ration, and unless also it is a ration which the poultry keeper intends to feed regularly.

From what was said earlier in this chapter the reader will rightly infer that poultry can be brought to adapt themselves to almost any diet or system of feeding by which they obtain enough to eat. But this is true of poultry, or of a kind of poultry, only in a general way. Individual birds vary both in the extent of their adaptability, and in the direction of adaptability; and the adaptation of a flock to a diet or a system of feeding unsuited to some of them is really brought about by the extermination of the individuals not adapted to it. They do not grow as others do. They are more susceptible to disease. So by a process of natural selection they disappear entirely within a few years.

Whether it is policy for a poultry keeper thus to adapt his flock to a particular system, depends upon his object in poultry keeping and the real merit of the system. In general, the good feeder works by the opposite rule, studying by every means in his power to provide the rations that are most palatable to the birds and that give the finest development.

CHAPTER II

Properties and Composition of Poultry Feeds

What Chemistry Finds in Feeds—Peculiar Properties and Uses of Cereal, Vegetable, Animal, and Mineral Feeds—Profitable Use of Commercial Mixtures and Condimental Feeds — Table of Analyses and Nutritive Values of Feeds of All Kinds—Explanation of Mathematical Calculation of Rations

WHILE it is chiefly the nutritive elements in feeds that concern the poultry feeder, most of the whole feeds and many of the by-products contain a considerable percentage of indigestible matter. The presence of this in a feed is often immaterial, as far as the results of using the feed are concerned, but may considerably affect the cost. Some indigestible matter is positively injurious, while some may be beneficial under certain circumstances. These points have to be considered in connection with the articles to which they apply.

NEVER TOO YOUNG TO BEGIN TO LEARN POULTRY FEEDING

Note equipment to suit scale of operations—a lard pail for mixing feed, an old milk pan for the water which the boy has learned ducks must always have with their feed.

Chemical analysis of feeds finds in them a great many different ingredients, but in the ordinary discussion of matters relating to feeding, these are considered in the few groups to one or the other of which each of the separate elements may be assigned. These are—protein, carbohydrates, fats, ash, and fiber. Mention of the functions of these was made in the preceding chapter. Here we have to consider their character more particularly.

Protein—The most familiar example of nearly pure protein is the white of egg, which contains no carbohydrate, just a trace of fat, and about one per cent of ash —with about seven times its bulk of water. This is of peculiar interest in a study of poultry feeding because in the results of the process of incubation we see a minute germ, quickened into life by the continuous application of a suitable degree of heat, grow to a perfectly developed chick, by a mode of assimilation of the tissue-forming material which the albumen of the egg provides. The solids of lean meat and blood are about ninety per cent or more protein. In milk the protein is in the form of casein. Pure, dry protein is a hard, horny substance; and in grains the hardness of the grain depends upon the amount of protein.

Carbohydrates—The apple and potato are the common food articles which contain the highest percentages of carbohydrates, and the lowest of both protein and fat. The white potato is almost clear starch. In the sweet potato a part of the carbonaceous material is in the form of sugar. In the common grains the amount of starch varies from fifty to seventy per cent. Grains and seeds which contain large amounts of oil are those in which a considerable part of the common proportion of starch takes the form of fat.

Fats—The familiar pure fats used in human food are butter, lard, oleomargarine, and the various vegetable oils. The common grains contain relatively small percentages of fat, running from about two per cent in wheat, barley, and rye, to five per cent in oats, and five to eight per cent in corn. The poultry feeds having the highest percentages of fat are the meat by-products, beef and pork scrap, which may contain as high as thirty to forty per cent of that element, and cottonseed and linseed products, which have the same wide range of fat content.

Ash—The common ash or mineral matters in feeds are phosphates of lime, soda, potash, etc. Chemistry finds some mineral matter in all feed articles, and some of the grasses and forage plants contain high percentages of it.

Fiber—The fiber in feeds is generally indigestible, and consideration of it in a study of feeding deals mostly with the question of the effect of the fiber in an article upon its palatability, and its possible irritating effects when too much is taken into the digestive system. The fibers are largely carbonaceous in character, though lacking in nutritive quality. Oat hulls are the most familiar form of fiber in poultry feeds.

Vitamines—Besides the five classes of food elements just described, investigators in food research have recently demonstrated the presence in most food articles in a natural state, of certain elements of great importance in nutrition which have been called vitamines. The chemical nature of these has not yet been satisfactorily determined.

AN OCCUPATION FOR DECLINING YEARS

This man, when he became too old to work at his regular trade, built a small poultry plant at the edge of the woods, and with about two hundred hens and the chickens raised to keep up the flock kept the wolf from the door in his old age without working beyond his strength. His feed pail is larger than that of the boy above, but his work and equipment are not "on a business footing."

COLONY HOUSES FOR LAYING STOCK ON FARM OF F. W. C. ALMY, TIVERTON FOUR CORNERS, R. I.

Their importance in nutrition is evident, but the amounts necessary or most economical in rations have not yet been found experimentally. In the present state of knowledge of the subject it appears that questions as to the use of vitamines are of little—if any—practical interest to stock feeders, because to a very great extent the conditions which reduce the normal quantities of vitamines in human diet, correspondingly increase the supply in by-products quantities of water-soluble vitamines, but much of the fat-soluble. Lard and sugar contain no vitamines. Ordinary lean meat contains little of either kind, but liver, kidney and heart have a good deal of both. Leaves and roots of plants contain much water-soluble vitamines, and any oil in them may contain fat-soluble vitamines. It does not appear that there is any danger of poultry fed a suitable variety of feeds lacking a sufficient supply of

BUSINESS-LIKE POULTRY FEEDING—IT PAYS TO USE HORSE POWER WHEN THE SCALE OF OPERATIONS WARRANTS

This is a common type of feed wagon, locally called a "dough cart", long used in Southeastern New England. All the feed and water for many flocks can be carried at one load. The type of poultry farming with the equipment shown on this page has been more continuously successful for large farm flocks than any other.

of the manufacture of human foods, which are used for stock feeding. Thus in the finer grades of wheat flour the vitamines are largely absent, nearly all in the wheat remaining in the coarser by-products.

Two kinds of vitamines are recognized,—water-soluble and fat-soluble. The first are said to be essential to sustain life, the others for the growth of the young. Both are found in whole milk. Butter has insiginficant vitamines. Hence special attention to them is not called for unless it should be clearly shown that their use in some specified way gives unmistakable greater efficiency in feeds, and especially in the use of cheap feeds.

Physical Properties of Feeds

In feeding practice it is often found that poultry show decided preferences between feeds having approx-

COOPS FOR YOUNG CHICKENS REARED WITH HENS ON FARM OF F. W. C. ALMY, TIVERTON FOUR CORNERS, RHODE ISLAND

imately the same chemical composition so far as the principal nutrients are concerned. To a limited extent such preferences may depend upon those nutrients being somewhat different in the form in which they occur; but as far as ordinary observation shows, the birds are governed in their preferences largely by the ease of obtaining feed, and by whether the act of swallowing it is attended by unpleasant sensations. They do not appear to have any nice sense of taste, but do seem to show some judgment as to whether a particular feed before them is worth eating. In general they take the feed that they can get easiest and show aversion to those containing large proportions of dry fiber.

Corn and Corn Products

Corn is at the same time the most valuable and the most dangerous of the grains fed to poultry. Its value comes from its cheapness (under normal conditions), its general availability, its high digestibility, and the fact that most kinds of poultry prefer it to other grains. Its dangerousness is due to the fact that it is the hardest grain properly to ripen, cure, and preserve; and that even when the whole corn has been well cured, the products milled from it are apt to heat and mold in warm weather, and when fed in that state may be highly injurious. Avoidance of the dangers of corn is a matter of care and good judgment on the part of the poultry keeper. Any unsoundness or unwholesomeness in corn products is easily detected by inspection, or such simple tests as may be applied by the poultryman.

AFTER THE CORN IS CUT ON A NEW YORK FARM
The chickens have been in it all summer but not visible to the camera. Chickens and corn are an ever-profitable combination.

The general preference of poultry for corn is by no means an exclusive one. In a mixture containing corn they are apt to eat the corn first, whether it is whole or cracked, but do not invariably do so. If they are fed up on corn and have had little of other grains, they will often lose appetite for corn and eat greedily of a grain like oats or rye, which ordinarily they would leave until all the corn had been consumed. The large size of the grains of whole corn, and its bright color evidently have much to do with its attraction for poultry, for it may be observed that they are much more partial to cracked corn that is clean and bright in appearance than to that which is bleached and dull looking. They will show this preference immediately when unattractive corn is placed before them. Hence we cannot conclude that it is perception of the inferior quality of the dull-looking corn that makes them reluctant to eat it.

Corn may be fed to poultry in any form—green or ripe, whole, cracked, coarsely or finely ground, raw, or cooked. It is not economy to feed green corn to poultry, and the only occasion for feeding it is to use green sweet corn from the garden that has become too hard for the table. Where the quantity of this is so small that it is not worth while to go to the trouble of thoroughly curing it, it is as well to feed it to poultry at once, for such odds and ends of sweet corn left about are apt to mold before they cure, or to be eaten by mice. Many people are afraid to feed unripe corn to poultry because they have heard much of the dangers of feeding new corn to other stock, especially to horses. As far as feeding to poultry is concerned there is no danger, provided the corn is sound and clean. If it has heated or is moldy there may be risk in using it freely, but in all cases of damaged or inferior feeds it is a safe rule to use the damaged article in such amounts as will be readily eaten once a day by poultry that are well fed at other times with sound feeds. This practice enables a poultry keeper to use to advantage feeds that may have become damaged on his hands, or that can be obtained at a price low enough really to justify their use.

In buying corn and corn products the appearance and texture are generally fair indications of their quality. The protein and the fat in a grain of corn are principally in the germ and near the outer surface, the starch appearing as the soft inside portion of the kernel. The more protein and fat the corn contains the larger will be the hard, darker-colored portions of the grain. By splitting a whole grain of corn or by noting the relative proportions of hard and highly-colored and soft, lighter-colored parts of the particles of cracked corn one can tell whether it is relatively high in feeding value or not. Of course these determinations are not accurate, but with experience the feeder's judgment may become good enough for practical purposes. The quality and texture of white corn are not as plain to observation as in yellow corn, but the same difference exists, and the judgment of the eye may be reinforced in the inspection of cracked white corn by testing the particles with the teeth. The color—(that is, white or yellow), does not influence the quality.

The quality of corn meal may be judged by the appearance, weight, smell, taste, and the effect of scalding with boiling water. Meal from ripe, hard, dry corn is bright and clean looking, and swells immediately when wet with boiling water of which it will take up a considerable quantity, making a sticky mush. Meal from poor corn is dull in color, light in weight, often smells stale or moldy, and when tasted lacks the flavor of good meal. Wet with boiling water it does not make an adhesive mass, but the particles remain separate and, when the mixture stands, tend to settle to the bottom like sand, leaving the water on top. There are, of course, all grades between good and poor meal, and the feeder learns by

A FAMILY OF WHITE TURKEYS FORAGING ON A RHODE ISLAND FARM
Turkeys are methodical feeders, and specialists in the extermination of bugs destructive to grass and grain crops.

long observation to judge each of the numerous grades at about its actual feeding value.

It is usually, though not always possible to get corn products of good quality, if purchasers insist upon having no other and return inferior goods when such are delivered to them. There occasionally are seasons when early frosts stop the growth of corn throughout large sections before it is thoroughly ripe, and after such a season little corn of really good quality may be available for stock feeding.

Corn and cob meal is not a common commercial product. Its use appears to be of most interest to poultry keepers who raise considerable quantities of corn, and who suppose that corn and cob meal would make a suitable substitute for a mixture of corn meal with wheat bran. As ground at home it is usually so coarse and so overloaded with fiber that poultry will eat very little of it. As occasionally found on the market it is much finer, and appears to be a mixture of corn chop and corn bran with not much, if any, of the cob in it. In general it is very poor economy to try to use the home-ground article, and the commercial product is valuable only for limited use with high concentrates.

Corn bran is the coarse outer covering of the grain separated from the meal. Corn feed meal is a mixture of coarse meal and bran separated from fine table meal. Corn gluten meal, corn gluten feed, and corn germ meal are by-products of the manufacture of starch and glucose. Their comparative feed values are indicated by the statements of percentages of the various feed elements which they contain, as given in the table on page 23.

Wheat and Wheat Products

Wheat is commonly rated the best grain for poultry. Its superiority is not due to greater feeding value, but to better keeping qualities and an almost complete absence of risk in feeding. Cases of sickness from the use of damaged wheat, while not unknown, are by no means common. Large quantities of wheat that have been damaged by water are dried and sold as poultry feed. Where the damage is slight and the wheat in fair condition, about as good results may be obtained as from sound wheat. Where the damage is great, as when wheat is badly scorched, it does not seem to injure poultry, but because of its unpalatability they will not eat it freely enough to thrive or lay well on it. Wheat of good milling quality is rarely offered for poultry feed except in wheat-growing sections where it may be the cheapest of the grains available, or in small lots by growers in sections where so little is grown that there are not facilities for milling or transporting it to mills. The feed wheat on the market generally is of a grade not desirable for milling, but as good as any for feeding purposes. Shrunken, shrivelled, and frozen wheat, and ordinary wheat screen-

DUCKS ON THE MARGIN OF A LONG ISLAND RIVER — ATLANTIC DUCK FARM, SPEONK
Ducks are often grown in dry yards, but the work is much lighter when they have water runs.

A MARKET POULTRY FARM IN THE SOUTH SHORE DISTRICT OF MASSACHUSETTS
(Continuation of this view on page 15)

ings, composed of small and broken wheat, often appear to be good for poultry feeding as the best commercial grades. As applied to wheat screenings this means clean screenings, free from large quantities of weed seeds and chaff.

The red wheats are generally better value than the white, being richer in protein, which makes them harder. The best way to test the quality of wheat is by biting the grains with the front teeth. Poultry eat wheat more readily than any other grain but corn. The difference in feeding value between good corn and wheat, as noted in ordinary practice, is imperceptible. Such advantages as one or the other may appear to have in particular instances are plainly due to conditions under which it is, for the time being, the more suitable feed. Experiments made at some of the experiment stations to determine the relative values of corn and wheat have given the same conclusions, though it must be admitted that the methods adopted sometimes have not been such as allowed a clear comparison. However, the conclusions arrived at generally accord with the observations of practical poultrymen.

Wheat by-products are the parts of the grain separated from flour in milling. They vary, according to the process of milling and the kind and grade of flour, to such an extent that for many years there has been great confusion in the identification of the different kinds and grades by the names that are applied to them. Since nearly all states now have feeding-stuff inspection laws, and products of this kind originating in one state may be, and commonly are, shipped to many others, the officials in charge of feeding-stuff inspections have cooperated to standardize the terms used in describing them. The definitions of wheat products as agreed upon by them are:—

"**Wheat bran** is the coarse outer coating of the wheat berry obtained in the usual milling process from wheat that has been cleaned and scoured."

"**Shorts or standard middlings** are the fine particles of the outer and inner bran separated from bran and white middlings."

"**White middlings or wheat white middlings** are that part of the offal of wheat intermediate between shorts or standard shorts or standard middlings and red dog. This term correctly applies to high grade middlings, low in bran content, thus being highly digestible. An off-grade flour which contains 2.5 per cent or less of fat and 13% or less of protein should not be confused with white middlings."

"**Wheat mixed feed or ship stuff** is a mixture of the products other than flour obtained from the milling of wheat."

"**Red dog** is a low-grade wheat flour containing the finer particles of bran."

In the feeding of poultry the wheat products are generally combined with other milled feeds, principally the corn products, though oat products are often used also. The most common commercial form is the mixed feed or ship stuff. Where "mixed feed" is mentioned as an ingredient of mashes this is what is meant unless it is specified that the reference is to one of the many mixtures of different grain products put out by dealers as complete feeds. These last would be more appropriately and plainly described as **mashes.**

Bran alone has little nutritive value and is obviously not attractive to poultry. Mixed with fine corn meal it gives desirable bulk to the mass, prevents it from packing in the crop, and supplies mineral elements in which the corn meal is lacking. Middlings mixed alone with water make a sticky, pasty mess. When bran and middlings—wheat mixed feed—are mixed with water, the consistency and palatableness are improved but still are not as good as when corn meal is added. A combination of these three ingredients, with a little meat meal added, gives a simple mash, of ingredients almost everywhere obtainable, and one of high efficiency. Hence the corn and wheat products are the usual base in standard mashes, variations and substitutions being made to utilize other ingredients that may be locally or occasionally more economical. Fur-

A MODEST BEGINNING

The business farm shown above began in this poultry house on a town lot. When Mr. H. D. Smith, Rockland, Mass., located on the farm shown above, he took the "first poultry house" with him.

MARKET POULTRY FARM—SHOWING COLONY HOUSES FOR GROWING CHICKENS ALL THE WAY BACK
(Continuation of view on page 14)

ther discussion of this is deferred until the methods of feeding are taken up.

Oats and Oat Products

The value of oats for poultry feed is extremely variable. Heavy oats with plump, full kernels and thin hulls are quite equal in value to corn and wheat. A moderate amount of hull does not seem to reduce either their palatability or their nourishing properties, as compared with what the birds will eat readily of the other grains mentioned. In the British Isles oats are commonly rated the best of grains for poultry, and many American writers, following English authority, have unstintedly praised oats, and as unsparingly condemned corn as poultry feed. The reason for the preference for oats in England is that the oats produced in the British Isles are uncommonly good, while the climate is unsuited to corn. In America, on the contrary, most of the oats produced are of medium to poor quality, while good corn may be grown almost everywhere. In the South oats are almost always poor and light. In the Northern States the quality is much better and the production much greater, yet enormous quantities of oats that seem to be entirely suitable for horse feed, are of little value for poultry feed. Canadian oats are, on the whole, better than our best northern oats, and the English opinion of the value of oats in poultry feeding is more applicable there than on this side of the boundary line. Another reason for the English objection to corn is that it makes yellow fat in poultry, whereas their markets prefer white fat.

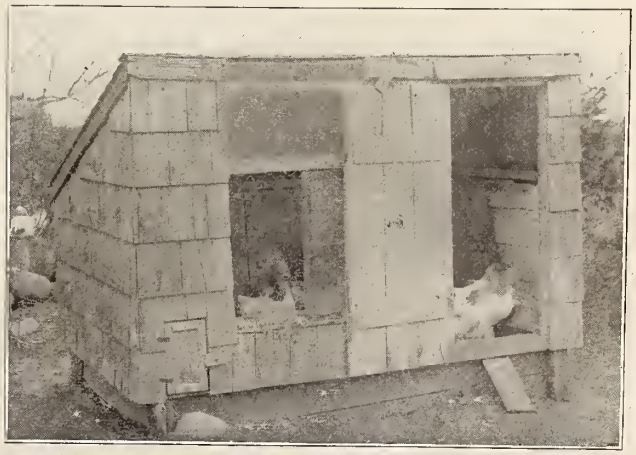
The ordinary examination of oats for quality is made by simply removing the hull from the grain. Anyone who has been feeding oats without examining them, and has perhaps wondered why his poultry did not appear to like oats and would eat little even when kept short of other grains to compel them to do so, will be surprised, when he examines an ordinary sample of the oats he has been feeding, to find how few grains contain large plump kernels, and how many are almost entirely hull. It does not pay to buy oats for poultry unless they are good enough so that the birds eat them readily as a part of a mixed-grain ration. Hulled oats make good poultry feed, but the price should not be higher than good feeding wheat.

Ground oats and mixtures of oats with other ground grains are common feed articles. Their value in either case depends upon the original quality of the grain, and the freedom of the mixture from additions of surplus oat offal from other sources. It is not possible for anyone to say positively upon inspection whether a sample of ground oats or mixed feed including ground oats, having an excessive amount of hull, was made of very poor oats, or was adulterated. The only question that really concerns the buyer is whether the proportion of hull is greater than desirable in a poultry feed. If it is, he should reject the article, for the excess of hull makes it an undesirable—an expensive and a dangerous feed. The hull in ground feeds, beyond a very small amount, is highly irritating to the intestines of poultry, and dangerously so in young poultry.

On the other hand, good ground oats, reasonably free from hulls, are a desirable and valuable feed to use either separately or in mixtures. So the intelligent and economical use of oats is a question of obtaining a good article at an appropriate price. Rolled oats and oatmeal are widely recommended as superior feeds for young chickens. They are good feeds when not stale, but whether they are the best feeds to use in any case depends upon the quality and prices of other available chick feeds, and especially upon whether the corn obtainable is good and safe to feed.

Barley and Barley Products

Barley as a poultry feed occupies a place between wheat and oats, as to its palatability, but is much less generally available than the other grains so far considered. Nowhere but on the Pacific Coast, where the bulk of our crop of barley is grown, is it regularly available for poultry feeding. In the markets throughout the rest of the country the supplies of barley are irregular and the prices compared with those of the grains to be had in abundance are inclined to be erratic. This last feature is probably due to the readiness of poultry keepers to pay a premium for a grain that is rather scarce, thinking that they can afford to do so for the sake of giving variety to the



ONE OF THE COLONY HOUSES ON FARM OF H. D. SMITH

ration. If poultry keepers generally would make a study of the relative feeding values of grains as apparent by the proportions of hull and waste that they contain, which can be determined by ordinary inspection, and then buy accordingly, the prices of all sorts of grains would soon be properly adjusted to the price of corn, which under normal conditions is nearly everywhere the cheapest grain obtainable.

Barley and wheat have about the same nutritive value, except that barley contains a larger percentage of fiber, the grain having a hull. Hulled barley and wheat should be bought for poultry feed at the same price. Barley with the hull is usually worth 10 to 15 cents a bushel, or 15 to 25 cents a hundred, less than an ordinary grade of feed wheat. The proportion of hull varies greatly, just as it does in oats, though good barley is much plumper than the best oats, and the poorest barley is rarely as poor as a large part of the oats on the market. Poultry that have never had barley sometimes scour badly if suddenly changed to a diet containing much of it, but the trouble usually disappears within a few days. If it does not, it may fairly be assumed that some other things in the ration or in the conditions to which the birds are subjected need attention and correction.

CHICKS IN BROODERS IN GRASSY YARDS AT GRANDVIEW FARM, AURORA, N. Y.—GRAIN GROWING IN FIELD BEYOND

Brewers' grains and malt sprouts, though commonly described as poultry feeds, are not generally used for that purpose, their chief use being as cattle feeds. The prohibition of the manufacture of liquors in the United States will take this class of products off the market, and it is entirely problematical whether barley will continue to be grown in quantities that will make it an important item for poultry feed. Its prime use has been for brewing, and its availability for stock feeding has depended upon the amount of surplus over what the brewers could use.

Rye and Rye Products

Rye is produced in America in much less quantity than any other of the common grains. The chief use of the plant here is for green forage for all kinds of live stock, and for the straw which is especially valuable for bedding and litter by reason of its length and extreme toughness. During the recent war period rye flour was extensively mixed with wheat flour for human food, and the value of rye in feeding animals appears to be greater in mixtures with corn than when the attempt is made to feed rye or rye products alone. Rye is said to produce digestive disorders, and anyone not accustomed to it who will eat a little pure rye bread will discover that it has in much greater degree the acrid properties sometimes noted in oat preparations. In parts of Europe where rye is more extensively grown than here, it is used for feeding all kinds of live stock, but authorities on feeding in those countries advise against feeding it alone, and also say that it gives better results fed cooked than when given raw. On the whole, the American poultry feeder need not concern himself much about this line of products. If he has rye on hand or can get it cheap he can use it in a limited way with other ingredients.

Buckwheat and Buckwheat Products

Poultry seem to like buckwheat in limited quantities, but not to care to make a full meal of it as they do of corn, wheat, or good oats. There is not much buckwheat available for poultry feeding in this country and what there is, is often of inferior quality, which perhaps accounts for the reluctance of the birds to eat it freely. In Europe, and particularly in France, buckwheat and its by-products, groats, bran and middlings, are much used in feeding poultry. French buckwheat is said to be superior to that grown in England. Some poultrymen here occasionally grow buckwheat on land they want to freshen, and use the unthreshed straw as litter, letting the poultry feed on the grain as they thresh it out by scratching. This practice might profitably be followed much more widely than it is.

Miscellaneous Grains and Seeds

Broom-corn seed, sorghum seed, flaxseed, cottonseed, kafir corn, millet, rice, etc., are suitable for poultry feed, but are not generally obtainable at prices that compare favorably with the common staples. Broom-corn seed, hulled, has given as good results as wheat after the fowls became accustomed to it. Kafir corn is now grown quite extensively on the dry lands of the Southwest and Far West, and there is an increasing use of it as poultry feed in and near the places where it is grown, but elsewhere supplies of it are irregular and, as a rule, the prices asked are too high. In warm climates that are too dry for corn, poultrymen should use kafir corn in the yards and on available land, just as corn is used in places that suit it.

Millet has not the value commonly attributed to it as poultry feed. Large birds eat its small grains reluctantly, and chicks thrive best if the amount of millet in their diet is limited to what they will take when well fed on grains that they like better. Any attempt to force them to eat considerable quantities of millet leads to underfeeding and restricted growth. Used moderately as an extra, it is a good feed, but even so it is not an economical feed unless the price is close to the price of corn.

Rice is an excellent feed for poultry, but the production of it in this country is so small, as compared with that of the common field grains adapted to general cultivation, that the amount used is insignificant. It consists mostly of broken and damaged rice, principally in prepared chick feeds. In this form rice may be given with entire freedom. There is no risk in its use, but the rice by-products (bran and hulls) should be given with more care. The bran is apt to contain a large mixture of hulls which are not only worthless, but may be injurious.

Cottonseed and flaxseed are of interest to the poultry feeder chiefly for their by-products. The primary commercial value of these seeds—apart from their value for planting—is in the oils extracted from them. In this process the seeds are pressed into cakes containing all the other elements and the residue of oil which the process did not remove. The earlier processes of extracting such oils left in the cake a high per cent of fat, but improved processes have so reduced this that the meal into which the flaxseed cake is ground before being placed on the market as a feed is very low in fat. Cottonseed meal is much higher in fat, because the oil is not so greatly in demand as linseed oil. The chief value in commercial oil meal is the protein it contains while cottonseed meal is rich in both protein and fat and, since meat by-products have risen to unusually high prices, there is an increasing use of both for poultry feed. A number of experiment stations have studied the relative values of cottonseed meal, and meat scrap, and the general conclusion arrived at is that it is a valuable substitute for meat scraps when only ordinary results are sought, but when the best results are desired meat scraps are more efficient because they are more palatable. Hence the partial substitution of cottonseed or linseed meal for meat scraps appears as the best method of securing maximum production at minimum cost, when meat products are high and these concentrated meals relatively cheap. The substitution of one of them for half the meat scrap in a ration does not appear to make it less palatable to the birds, or in any way to diminish its feeding value, and the saving in cost, while small on one day's ration makes quite a substantial amount when applied to long periods and large flocks.

Most kinds of poultry are fond of peas but care little for beans. This seems quite singular in view of the fact that in their composition these two seeds are much alike—as far as principal feed elements are concerned. It is also remarkable that beans—one of the most universally popular human foods, have no attraction for poultry in their raw state, while peas are eaten greedily. Most kinds of poultry will eat raw, dry beans only under pressure of great hunger, and then only in limited quantities. Thoroughly cooked beans they will eat freely and with apparent relish, and they also readily eat bean meal when mixed with other mill products.

According to tradition, sunflower seed is a valuable feed for poultry, a little of it added to the ration being (so it is claimed) peculiarly valuable for hens while molting. This appears to be another of the cases where the apparent value of a feed depends upon the combination in which it is used. In a ration lacking in fat, plump, well-filled sunflower seeds given as liberally as the fowls would eat them, would undoubtedly show marked beneficial results, but ordinary observation cannot discover any advantage in feeding them to birds that have a liberal amount of corn and of meat scrap or oil meal. Much of the sunflower seed given to poultry is immature and contains little nutriment—so little that well-fed birds will hardly touch it. If one buys sunflower seed he should examine it to make sure that there is something more than hull, and he should keep in mind that an average good sample is about one-third hull, and the actual nutritive value less than that of corn. A little of such an article is useful for the sake of variety, and for that purpose it may be worth a little more than the staple grains used in the ration, but it is extravagant to pay several times the common prices; for such extras, as poultry keepers frequently do.

COLONIES OF WEANED CHICKS IN ORCHARD ON A NEW YORK FARM—AN IDEAL PLACE TO GROW CHICKENS
Windfall apples make good feed and the chickens destroy insects that would spoil fruit.

Vegetable Feeds

Vegetable substances used for feeding poultry, other than grains and their products, may be divided into two general classes; leaves and forage, and roots and fruits.

All kinds of poultry will eat tender, succulent green stuff in much larger quantities than are generally given to them in confinement, but a great many things of this kind they care for only in their tender stages of growth, eating them at other stages only when nothing else of the kind can be obtained. Cabbage is the most useful vegetable of this class for poultry feeding, considering its keeping qualities and the possibility of having supplies through almost the entire year.

For feeding as cut, or for growing in poultry yards where the birds can eat of it at will, rape is popular. Lettuce is perhaps the favorite with the birds, but as a rule the only lettuce that can be profitably fed to them is that which has passed the stage at which it is used for human food. These three things poultry will eat regularly and freely. Most of the common root crop tops, such as beet

leaves, onion tops, etc., they eat in small quantities when tender, fresh and crisp, but do not care much about when tough or wilted. Grass that is kept short, and all kinds of leaves of weeds growing in such grass, are eaten by poultry with great relish and in surprisingly large quantities; but as soon as any such vegetation gets a little hard and tough they eat it sparingly if anything else more succulent can be obtained.

Of roots, the most useful for poultry feeding and the one most widely grown expressly for the purpose, is the mangel-wurzel beet. After this come sugar beets and large table beets. Turnips are widely used, but as they sometimes give an unpleasant flavor to eggs poultrymen have to be more cautious in feeding them. The bad flavor from turnips seems to be due sometimes to the "rankness" of turnips grown on strong land, and sometimes to the birds eating partially decayed turnips.

Stock carrots, table carrots, potatoes, and onions all make good poultry feed. The question of their use is a matter of availability or cost. Where there is a surplus of such stuff of unmarketable grade, it is cheap poultry feed. If it has to be bought, the price should be based not on the value of the marketable stuff of the same kind for human food, but on the value of the waste product in comparison with the staple poultry feeds. This point will be explained more fully in connection with the discussion of the values of feeds as shown by the general measurement of nutritive value.

BREEDING DUCKS AT ATLANTIC FARM, SPEONK, L. I.
These ducks can get a good deal of animal feed from the water, and therefore do not need extraordinary amounts of it in their ration.

Of common fruits the apple is most generally available for poultry and has the advantage that spotted and bruised fruit will keep much longer than similar fruit of peaches, pears, and plums. None of these things need go to waste if there is poultry to which they may be fed, and birds that have at the same time free access to corn or wheat and to any of these, seem to get a well-balanced ration. Tomatoes are in the same class with the things just mentioned, but rather lower in actual feeding value. Cucumbers and all kinds of melons are greedily eaten by poultry.

Clover and Alfalfa

As poultry generally do not care for green grass after it becomes a little hard and tough, hay to be attractive to them must be made from grass cut at the stage at which they prefer it, and cured to preserve the green color. Clover and alfalfa are most suitable for this purpose, and are more conveniently handled and fed when ground into meal or cut very finely. While there is not much difference in the feeding value of the two when both are of like grade, the weather generally in alfalfa-growing sections is more favorable for curing than in clover-growing sections. Hence a much larger proportion of the alfalfa is nice in color, and in every way attractive, and alfalfa tends steadily to displace clover in the poultry ration wherever they come in competition.

Animal By-Product Feeds

There are two sources of supplies of this kind—local supplies consisting of the wastes and trimmings from small butcher shops, from the family table, and perhaps an occasional old horse; and the general commercial supplies put up in convenient form and ready for use, by all classes of packing plants handling meat and fish products. Supplies from local sources are generally limited and irregular. At the same time they are often the most desirable to use as far as they will go, if they can be obtained at reasonable prices and their preparation for use does not involve too much time and labor. Except for small flocks, local supplies as a rule are of little consequence. The multiplication of poultry keepers in towns and suburbs tends to divide available local supplies until the amount that any one poultry keeper can get becomes so small that it is hardly worth his while to look after it. He finds it much more convenient to buy, in quantity to suit his needs, meat scrap, meat meal, dried blood, fish scrap, and other similar preparations which will keep indefinitely, and are always ready for instant use.

Nearly all experienced poultry keepers consider green cut bone, which usually has with it considerable fresh meat, the best of animal feeds for poultry, and the one which supplies the additional mineral matter needed in most palatable form. But few poultry keepers that have large stocks can get anywhere near as much of this as they could use, and unless they have a power cutter they are apt to prefer prepared feeds exclusively, for while cutting bone for a small flock is good exercise, the man who cuts on a large scale needs to be properly equipped for it. Meat and fish by-products as sold for poultry vary considerably in composition. Dried blood and blood meal are largely albumin, but most of the brands of meat meal on the market are high in fat. As far as

YOUNG DUCKS REARED WITHOUT ANIMAL FEED
Same age, and originally same number as flock on opposite page.

feeding quality goes, practically all are valuable additions to the ration, and the choice—if there be any—between brands of different composition is a matter of price as compared with content. The best way to compare values is on the reports of their composition as published by the experiment stations which are by law authorized to analyze feeds and to publish the results for distribution to consumers in their states.

It is a noteworthy fact that the greatest danger in using this class of poultry feeds comes from the frequency of their containing much more protein and fat than the manufacturer has given on his label or bag as his guarantee. The manufacturer does this for his own protection against the possibility of many lots of goods running below the guarantee if he places that too high, since he cannot in a waste product of this kind make uniform quality as he would in a standard product. The consumer not being informed of the situation assumes that the guarantee gives exact composition and uses it accordingly. Manufacturers themselves sometimes advise the proportion of an article to use, basing it on their guarantee. This is a mistake in the case of a high concentrate of variable quality, for it often leads the user to put into a mixture more than should be used, considering other elements in his ration. Then if bad effects develop the feeder supposes that there is something injurious in the feed, when the whole trouble is that he is regularly using a little too much of it.

The question of feeding value in feeds of this class cannot be determined by the agreeableness or disagreeableness of the odor. Some have a rather agreeable odor when moistened—especially when mixed with hot water. Others have a disagreeable odor—rather suggestive of fertilizer. It is natural to conclude that the better smelling article is in every way better, and poultrymen generally are inclined to give it the preference; yet it happens again and again that when they cannot get the article they prefer, and are compelled to use one that on odor they pronounce less desirable, they find it in every way as satisfactory as the other. Occasionally a lot may be damaged in some way so that it is unpalatable and unfit to feed, but in general what the chickens will eat readily will not injure them, unless an excessive quantity is given, and the proof of quality is in the results. Nearly all meat scraps and fish scraps contain considerable amounts of mineral matter.

YOUNG DUCKS GROWING FOR MARKET AT ATLANTIC FARM
In such numbers the ducks each get little of the animal feed in the water, and must have heavy proportions of meat in their rations.

YOUNG DUCKS REARED ON HIGH PROTEIN MEAT SCRAP
Same age as those on opposite page.

Milk and Milk Products

Milk in any form is good poultry feed. If it appears to have bad results in any case the trouble can usually be located in an undesirable combination of something else with the milk, or in extreme susceptibility of certain birds to the effects of such changes as from sweet to sour milk. The general statements that have been put out as to the inadvisability of feeding both sweet and sour milk, as to peculiar virtue for sour milk, and as to bad effects of sweet milk, are all based on limited observation and special instances, and some of the most widely quoted of them were soon corrected by those issuing them, but the error always seems to spread faster than the correction.

A poultry keeper may find that milk, or milk in a particular form, does not agree with his birds or with some of them. The logical thing to do is to investigate, in order to find the reason and to correct it, for when milk seems to disagree with poultry there is something else to be corrected. It may be that the amount of meat in the ration is excessive in connection with the amount of milk used. In one case observed, where sweet skim milk was said to scour laying hens, the trouble was that, with a dry mash containing a large proportion of nice alfalfa meal, and the vessel of milk standing close to the feed hopper, the hens ate mash and milk so freely as to produce the peculiar looseness of the droppings that goes with heavy feeding of green alfalfa. If milk seems to have bad effects there is always a reason, and usually a simple, easily remedied one.

Skim milk and buttermilk are the forms in which milk is commonly available. Regular supplies of these are generally to be had at really low cost only on farms where butter is made, or in the vicinity of creameries. At present there is a partly solidified form of buttermilk on the market that is very good for poultry feed. This "semi-solid buttermilk" as it is often called, is given to chicks at all stages of growth and is considered especially desirable for them, as milk is believed to have an exceptionally favorable effect upon growth. Many poultry feeders supply semi-solid buttermilk also to laying fowls, while it is regarded as almost essential in rations for special fattening. As a drink for chicks it usually is di-

FARRER BROS.' MARKET POULTRY FARM, WEST NORWELL, MASS.—ONE OF THE FIRST SUCCESSFUL LARGE PLANTS OF THIS CLASS, ESTABLISHED ABOUT 1890

Heavy production of poultry on a small area has at times made it necessary to limit operations with poultry and purify the soil by raising vegetable crops—after which it can be again used for poultry. The nearest thing to a "panacea" for poultry diseases is CLEAN LAND.

lted with water, but may be given to hens just as it comes from the barrel in which it is shipped.

At various times in the past milk products in dry form, convenient and desirable for poultry feed, have been put on the market. Everything of this kind is good for poultry. The question of feeding any particular article is the question of price. A number of milk by-products have been withdrawn from sale as poultry feeds after their reputation had been well established, because the manufacturers had devised a way of preparing them for human food and could dispose of them for that purpose at higher prices than they could obtain for stock feed.

Mineral Feeds

The most important of the mineral feeds is oyster shell. Hens that are well supplied with it do not seem to require anything else to provide material for egg shells, nor will they (in the writer's experience) consume any appreciable amount of indigestible grit when that is supplied on the theory that it is necessary to aid the gizzard in grinding the feed. Any shell or lime in form that it can be fed to birds seems to answer the purpose of supplying mineral elements needed, and it would appear that on soils containing much finely broken stone, poultry are able to get from such matter all the mineral elements they need for the ordinary purposes of growth and maintenance. Both young and old stock on good range appear quite indifferent to special supplies of bone or shell, except as material is plainly needed for egg shells. Under other circumstances, especially when quite limited for range and on ground that has been long used for poultry, and perhaps overstocked with it much of the time, the use of considerable amounts of bone meal in the feed of growing poultry has shown marked beneficial results.

While ground oyster shell is the most generally available of things of that character, very small sea shells which can be eaten without grinding are just as good, and are largely used by poultry keepers living near the seashore. Poultrymen in places where such shells are abundant sometimes do a considerable trade selling this material within convenient shipping distance. There are also in some inland localities beds of infusorial earth and deposits of chalky or gravelly stone which disintegrates easily, and this material seems to supply all the mineral feed requirements of poultry.

In general practice it is better to supply materials of this kind separately, so that the birds can take as much as their appetites seem to require, than to undertake to mix them with the feed in any definite proportions. They can be mixed with ground grains only when in the form of meal, as bone meal, or finely ground oyster shell. Fed in this way they frequently cause irritation of the intestines. In some experiments in the use of ash and grit for chicks, sand has appeared to be as effective as bone or shell, and some have inferred from this that it was the gritty character of materials of this kind rather than their digestible elements that made them valuable to poultry. That conclusion however ought not to be accepted without inquiry into the character of the "sand" used, and the possibility of its dissolving into small particles, and—in fact—being digestible. Coarse sand mixed with poultry manure that afterwards stands for a long time sometimes entirely disappears, not a trace of the grains of sand remaining. The processes of digestion

A LONG BROODER HOUSE ON FARRER BROS.' FARM
This is the building at the extreme right (and only partly seen) in picture above.

might have the same effect, and perhaps reduce the sand much more speedily.

Division of opinion as to the function and need of grit need not confuse anyone as to the course that he should follow in feeding. All admit that some digestible

SMALL COLONY HOUSE USED FOR CHICKENS AFTER LEAVING THE BROODERS, ON FARRER BROS.' FARM

In these 6x8 ft. houses fifty winter chicks are carrier to marketable size for large roasters. The window is never closed, and the door open nearly all the time, day and night.

mineral matter is needed. If poultry are constantly supplied with oyster shell and granulated bone they will certainly get all of it that they need, and a small supply of a grit that is certainly indigestible will then be found to last indefinitely. If the grit provided is eaten freely by birds that have plenty of shell and bone, it may be concluded that it is valuable as a source of supply of similar mineral elements.

Commercial Mixed Feeds—Their Place in Feeding Economy

The foregoing discussion of feeds has been confined quite closely to feeds in their natural forms or as simple by-products. There is a large class of mixed feeds formed by combinations of both whole feeds and by-products that is of great interest and calls for special attention. It is of considerable importance to the poultry feeder to have a correct understanding of the place of these feeds in good feeding practice, and of the extent to which he can use them to advantage, and also of the nature of the service performed by the manufacturers of such feeds, and of the means for protecting consumers against misrepresentation and adulteration of a class of feeds which offers special temptations to manufacturers or dealers inclined to be dishonest in preparing or handling feeds.

Commercial mixtures of ground feeds are made generally and primarily for the sake of adding to by-products of grains used for human food the elements that will substitute in a stock feed for those that were taken out. Thus one of the oldest mixtures, called provender, combined coarse bran with ground corn and oats. As by-products became more numerous and abundant, it was to the mutual interest of the manufacturers and of a large class of those who used them, to make mixtures of feeds for special purposes at the mills. With the increasing use of mixtures of ground feeds there came a demand also for mixtures of grains—whole and cracked. This demand came in the first place from small poultry keepers who did not want to buy numerous different articles in small lots, at the highest retail prices, and also—to some extent—from poultry keepers buying on a larger scale, who were not disposed to take the trouble of studying out the most desirable combinations for themselves, or who, when they did so and tried to make their own mixtures, found more or less difficulty in obtaining supplies of certain articles wanted.

It was the demand of these classes of poultry keepers that led to the extensive manufacture, advertising, and sale of commercial brands of poultry feed. The high grade and generally uniform quality of the popular standard brands of both mash and scratch feeds for poultry has led to their extensive use among poultry keepers who do not use them exclusively, because their cost as a rule is higher than that of average feeds the poultryman mixes for himself, but who find the commercial mixtures especially desirable for young poultry, and the most economical means of supplying more variety in grains than the stocks of local grain dealers afford. In fact it is the absorption of nearly all desirable supplies of miscellaneous grains by the plants that manufacture commercial poultry feeds, that keeps these out of the general market.

While the special commercial mixture of scratch feed has a variety of grains not easily obtained in any other form, and is therefore of peculiar value to poultry keepers whose stock is restricted for range, it is also highly valuable because of the uniformly high quality of the corn which is the basis and the greater part of most such mixtures. One of the greatest troubles in poultry feeding in America is to get good cracked corn, bright, clean, and free from mold in warm, damp weather. The difficulty has been greater in recent years because of the extent to which farmers all over the corn belt, in their eagerness to get large yields, have planted slow maturing corn, the growth

TYPE OF POULTRY HOUSE USED FOR GROWING SOFT ROASTERS ON A SMALL SCALE

These houses are detached, and each has its own small yard within a large yard. This admits of closer control of the chickens especially while small. Many persons with a few small houses of this type, or a little larger, hatch or buy several hundred chickens late in the season, to be sold when prices are highest in the spring. From such small plants nearly all successful large ones have grown.

of which often is checked by early frosts, making enormous quantities of soft corn which is not desirable for meal or to crack, and which deteriorates quickly after milling. The large manufacturer of poultry feeds partly avoids the dangers of using poor corn by buying in corn-growing sections the best corn obtainable, and further overcomes them by artificially drying the corn before grinding or cracking it.

After a season like that of 1917 when it was estimated that fully sixty per cent of the corn grown in the United

EMBDEN GEESE GRAZING

There is an old saying—"a goose eats everything before it and spoils everything behind it." This is true only when they are given poor pasture.

States was soft, even the large feed manufacturers must use some soft corn, but as what they use is dried it is far superior to the greater part of the corn on the market, and will keep in good condition for more months than the ordinary run of goods will keep weeks. The poultry keeper who finds his local supply of cracked corn unreliable or undesirable buys at least enough of a popular standard commercial mixture to provide against the contingency of being unable to get good corn locally in hot weather. Hence, while perhaps comparatively few large poultry keepers use commercial mixtures exclusively, practically all buy them in large quantities.

The popularity of widely known commercial mixtures, both mashes and scratch feeds, and the frequency with which the demand for them outruns the supply, leads millers and dealers in all localities to imitate them, or to offer substitutes of their own compounding. While in some instances these may be as good as the originals, in general they are not, for the corn products in them are likely to be the same inferior articles which the poultry keeper wishes to avoid. The best way for a poultry keeper to keep informed as to the values of all supplies on the market is through the report of his experiment station upon the different brands of commercial feeds sold in his state. A list of the experiment stations will be found on page 111. These reports protect both the consumer and the honest manufacturer.

From what has been said the reader will see that the question of buying commercial mixtures, or of buying the ingredients separately and making his own mixtures, depends upon the conditions under which his flock is kept, upon the quality and regularity of local supplies, and upon his own inclination or ability to judge of the values of feeding stuffs as found on the market, and to compound rations. Stock on good range, with abundance of green feed and natural animal feed may eat soft corn or somewhat heated corn without being any the worse for it, and will not suffer for lack of more variety in grains, while stock in bare yards will quickly show the effects of poor corn, and is more cheaply fed on a good commercial mixture than on a variable supply as selected by a keeper who pays little attention to the quality of the feeds delivered to him.

Condimental Poultry Feeds

Condimental poultry feeds are preparations in which articles having stimulative and tonic properties, and others of some value in the treatment of common ailments, are mixed with a base or filler of some common feed suitable for the purpose, the preparation to be used in small quantities in the mash. The regular use of such preparations parallels the use of spices, seasonings, and mild stimulants and correctives in human diet. That some use of such things is necessary is a matter of common knowledge. The real questions at issue between those who advocate and those who discourage the use of proprietary articles of this class are, whether this is the most economical way to give stimulants, tonics, and correctives regularly, and whether it is better to use them as general remedies, on the poultryman's own judgment, or to treat cases of disease each in accordance with its peculiar needs, and upon competent medical advice.

Especially stimulating preparations known as egg foods have to the present time been the most generally effective substitutes for the high seasoning and spicing in human diet, which gives to ordinary table waste much of its special palatableness and value as poultry feed; one reason for this is found in the simple fact that a great many poultry keepers who are careless about supplying these things as seasoning to make a ration more palatable to the birds, will be very faithful in giving the same ingredients, with others of a stimulating nature, when the direct purpose is especially to stimulate egg production. Again in stock of low vitality, and quite generally in stock of ordinary vigor in long seasons of raw, chilly weather, and when birds seem inclined to molt slowly, the use of such preparations is commonly attended with marked beneficial results, and on the whole the use of those having medical value is probably much safer for the average poultry keeper than to attempt to treat his stock for a particular disease with a particularly appropriate remedy for it.

To get medical advice for poultry that seems somewhat out of condition is not often practical. Except where the stock is valuable and something seems to be seriously wrong, the expense of securing advice either from a doctor or an expert poultryman competent to treat the situation is prohibitive. So while a poultryman who has some skill in the diagnosis of poultry ailments, and some knowledge of the particular remedies for each, may use his special knowledge rather than a general remedy, the average poultry keeper is more successful, as a rule, in the use of feeds with condimental and some

A FAMILY OF RHODE ISLAND "MONGREL GEESE"—WILD GANDER, AFRICAN GOOSE, AND FOUR CROSS-BRED GOSLINGS

These are considered the finest of table geese. They are grown mostly on grass in good pastures, grain being fed in very limited amounts, except by those who buy and finish them for market.

medicinal properties which tone up the birds, help digestion, regulate the bowels, and help nature to resist and throw off specific troubles that may be developing.

The practical thing for a poultry keeper who thinks perhaps his poultry would be the better, regularly or occasionally, for something of this kind is to try it out. He can demonstrate for himself whether there is an advantage to him in using it, and if he finds that there is, he can decide for himself whether it is better for him to continue its use, or to make such changes in feeding and conditions that there will be no occasion to use them to the same extent.

Kitchen and Table Waste as Poultry Feed

Under this heading should be included the kinds of feeds that come from the table, whatever their source. Thus we have all sorts of garbage from hotels and restaurants, and waste bread, broken crackers and the like from bakeries. None of these things come on the general market. The refuse from cracker factories is the only article of the sort that can be bagged and handled as staple feeds are, and this is nearly all bought up in advance by the large duck farms. What they may leave is taken by poultrymen near the factories. Stale bread is usually sold to near by poultrymen or, in metropolitan districts, it may be collected by men who peddle it out in lots of a few bags to suburban poultry keepers. The higher class hotels and restaurants now usually either have their own farms where their waste is fed to poultry or hogs, or their waste is taken by someone who uses it for feeding hogs, as also is most of the waste from cheaper hotels and restaurants. The obstacle to getting for poultry what is desirable feed for them in this waste is that it requires separating what the poultry will not eat, and disposing of it for swine. As feeders of swine will take everything, keepers of hotels and restaurants who have not farms of their own will not go to the trouble of keeping waste in such manner that poultry keepers can use it. So with the exception of occasional supplies of stale bread, the average poultry keeper's use of this class of feeds in closely limited to what comes from his own household.

Eggs

Of by-products of the poultry yard only infertile eggs and those in which the dead germ has not yet decomposed are available for feeding, and their use is generally limited to feeding the chicks the first few days. Infertile eggs that can be tested out at the third or fourth day, as can readily be done with white-shelled eggs, are as good for culinary purposes as ordinary stale eggs, and even eggs tested out after seven days of incubation are marketable for some purposes, so that the feeding of infertile eggs is less common than some years ago.

Analyses and Nutritive Values of Articles That Are or May Be Fed to Poultry

	Water Per cent	Fiber Per cent	Ash Per cent	Protein Per cent	Starches, Sugars, etc. Per cent	Fat Per Cent	Nutritive Ratio	Fuel Value (a)
Corn and corn products								
Field corn	10.9	1.9	1.5	10.4	70.3	5.0	1:7.9	106
Sweet corn	8.8	2.8	1.9	11.6	66.8	8.1	1:7.5	111
Pop corn	10.7	1.8	1.5	11.2	69.2	5.2	1:7.3	107
Small and immature field corn	35.7	1.0	0.9	7.3	50.7	3.5	1:8.1	68
Cracked corn	12.3		1.3	8.6	73.9 b	3.9	1:9.5	103
Corn bran	9.8	6.3	2.6	10.7	63.2	7.4	1:7.3	105
Corn meal—unbolted	12.0	2.2	1.3	8.7	74.1	4.7	1:9.5	104
Corn meal—bolted	12.0	1.2	1.0	8.9	72.0	4.9	1:9.5	106
Corn meal—granulated	12.5	1.0	1.0	9.2	74.4	1.9	1:8.6	102
Corn and cob meal	15.1	6.6	1.5	8.5	64.8	3.5	1:8.6	94
Corn germ meal	10.7	4.1	4.0	9.8	64.0	7.4	1:8.4	105
Hominy meal	11.1	3.8	2.5	9.3	64.5	8.3	1:8.7	108
Gluten meal	9.6	1.6	0.7	29.4	52.4	6.3	1:2.3	111
Gluten feed	8.1	6.4	1.3	23.2	54.7	6.3	1:2.9	107
Wheat and wheat products								
Wheat	10.5	1.8	1.8	11.9	71.9	2.1	1:6.3	102
Wheat screenings	11.6	4.9	2.9	12.5	65.1	3.0	1:5.8	97
Wheat bran	11.9	9.0	5.8	15.4	53.9	4.0	1:4.1	90
Wheat middlings	12.1	4.6	3.3	15.6	60.4	4.0	1:4.7	98
Red dog flour	9.5	2.1	3.0	16.9	63.9	4.6	1:4.4	106
Low grade flour	10.6	1.1	1.4	13.3	71.5	2.1	1:5.7	104
Mixed feed (bran and middlings)	10.6	9.7	3.6	12.0	59.9	4.2	1:5.8	94
Oats and oat products								
Oats	11.0	9.5	3.0	11.8	59.7	5.0	1:6.1	96
Oatmeal	7.9	0.9	2.0	14.7	67.4	7.1	1:5.8	113
Oat bran	7.7	19.3	3.7	7.1	57.9	2.3	1:8.9	81
Oat feed	8.2	12.5	4.2	12.6	56.3	6.2	1:5.7	96
Oat middlings	9.2	3.8	3.2	20.0	56.2	7.6	1:3.7	108
Rolled oats	8.4		1.9	15.0	66.6	7.5	1:5.7	114
Barley and barley products								
Barley	10.9	2.7	2.4	12.4	69.8	1.8	1:6	100
Barley screenings	12.4	7.6	3.6	12.2	61.6	2.6	1:5.8	92
Barley meal	11.9	6.5	2.6	10.5	66.3	2.2	1:6.8	93
Malt sprouts—dry	10.2	10.7	5.7	23.2	48.5	1.7	1:2.3	87
Brewers grains	8.2	11.0	3.6	19.9	51.7	5.6	1:3.3	97
Brewers grains—wet	75.7	3.8	1.0	5.4	12.5	1.6	1:3	24

Explanation of the Feed Table and of the Method of Using It

The first column in the table gives the amount of water in each article. All feeds have some water. The common grains when dry and whole have about ten per cent of their weight in moisture. When ground or cracked, the percentage of water is slightly increased. Green feeds generally have nearly 90 per cent of their weight water, but there is considerable variability in the table, and in many cases the difference in water appears to be due to difference in condition at the time of analysis, one of the articles being more dried or more mature in growth than another, rather than to actual differences in composition—as far as moisture is concerned. The amount of water in a feed does not affect its nutritive value, but may affect its cost value.

The second column gives the percentage of fiber. A single glance at this column is all that is necessary to show whether a feed has an objectionable proportion of indigestible fiber. An article that has more than five or six per cent of fiber is not generally eaten with much relish by poultry. Fiber is the one element in feeds that we want as low as we can get it.

The third column gives the ash or mineral matter in the article. This is higher in the by-products, as a rule, than in the grains and their straight milled products, but it really is not of much importance, because the mineral in feeds is generally insufficient and the deficiency can be supplied cheaper in shell and bone than in grain stuffs.

The fourth column gives the protein—the flesh formers. The grains run about 10 to 12 per cent protein, but the seeds run much higher, and the solid animal products generally higher still. In considering the feeding values of articles much higher in protein than the common grains, the principal point is their availability and the cost of using them to make up the possible deficiencies of protein in the grains and by-products which constitute the bulk of the ration. Sometimes one is more economical, sometimes another.

The fifth column gives the carbohydrates, consisting of starches and sugars and like elements. In the common grains, when dry, these are about 60 to 70 per cent, and knowing that somewhere near this amount is required for average normal circumstances, we can see at a glance whether an article approximates normal requirements, and by looking at the next

column can tell whether an article below normal in these elements makes it up in the more concentrated carbonaceous elements.

The sixth column shows the per cent of fat. In the common grains this is from 2 to 5 per cent. Theoretically a large per cent of fat will compensate for a deficiency in starch, etc., but in practice it is found that the large use of fats makes a feed either unpalatable to the birds or injurious to their digestive organs, hence the article with high per cent of fat is to be considered chiefly in view of the possibility of making this supply deficiency of fat in more bulky materials.

The seventh column gives the nutritive ratio; that is, the ratio of the flesh formers to the heat and energy producers. The percentage of the nutritive elements in a feed being known, the method of computing the nutritive ratio is as follows: The fat is reduced to terms of carbohydrates by multiplying by 2.25, this being done because fat has 2.25 times the heat and energy producing capacity of the carbohydrates. This result added to the carbohydrates gives us the total of the heat-producing elements. The remainder of the process is simply a matter of statement, and of reducing the statement to its lowest numerical terms.

To illustrate with corn: Multiplying the 5 per cent of fat by 2.25 we find that it is equivalent to 11.3 per cent of carbohydrates. Adding this to 70.3 (the value of the carbohydrates), we have 81.6 as the total percentage of heat producers. The percentage of protein is 10.4. Expressing the two quantities in the form of a ratio we have 10.4:81.6, and reducing this to its simplest terms we have 1:7.9 as the nutritive ratio of corn. The ratio is independent of the quantities of the feed, it is simply an expression of the relative proportions of the elements in the feed.

The last column gives the fuel value, a term synonymous with potential energy and preferred for use in tables because it is shorter. This value is an actual and not a relative one, and must be taken for specific quantities of articles. In tables of poultry feeds it is usual to give the number of heat units in one ounce. One advantage of this is that the common grains happen to have an energy of about 100 calories per ounce, and taking this as the average normal requirement we have 100 as a convenient standard for ordinary mental comparisons and calculations such as we make generally in practical feeding.

The fuel value of an article is ascertained originally by burning it and measuring the resultant heat. The fuel values of its different elements are ascertained by burning them separately after they have been chemically separated. In this experimental way it was found that an ounce of protein and an ounce of carbohydrates have the same fuel value—116 calories, while an ounce of fat has a fuel value of 264 calories. (It will be noted that this is a little more than indicated by the factor 2.25 which we use in reducing fat to terms of carbohydrates in determining nutritive ratios. The 264 is accurate; the other disregards a small fraction). The calculation of fuel value in an ounce of a feed therefore is simply a matter of finding the value of the combined protein and carbohydrates, by multiplying the percentage of the two by 116, then finding the value of the fat by multiplying the percentage of fat by 264; and adding these results.

Taking corn as an example: An ounce of corn is 10.4 per cent protein and 70.3 per cent carbohydrates; that is, 80.7 per cent of it has a fuel value of 116 calories per ounce. If an ounce has a fuel value of 116 calories, 80.7 per cent of an ounce has a value of (116 x .807) calories, or disregarding the third decimal (116 x .80) calories, which gives us 92.8 calories as the heat value of these elements. Corn being 5 per cent fat, and fat having a fuel heat value of 264 calories per ounce, the heat value of the fat in an ounce of corn is found by multiplying 264 x .05, which gives us 13.2 calories in the fat in an ounce of corn. Combining our two results we have 92.8 plus 13.2 equals 106.

Analyses and Nutritive Values of Articles That Are or May Be Fed to Poultry
(Continued)

	Water Per cent	Fiber Per cent	Ash Per cent	Protein Per cent	Starches, Sugars, etc. Per cent	Fat Per Cent	Nutritive Ratio	Fuel Value (a)
Rye and rye products								
Rye	11.6	1.7	1.9	10.6	72.5	1.7	1:7.2	100
Rye bran	11.6	3.5	3.6	14.7	63.8	2.8	1:4.8	98
Rye middlings	9.7	5.3	4.7	16.3	60.5	3.5	1:4.2	98
Buckwheat and buckwheat products								
Buckwheat	12.6	8.7	2.0	10.0	64.5	2.2	1:7	83
Buckwheat bran	14.0	14.7	3.4	17.1	46.4	4.4	1:3.8	85
Buckwheat middlings	13.2	4.1	4.8	28.9	41.0	7.1	1:2.1	101
Rice and rice products								
Rice	12.4	0.2	0.4	7.4	79.2	0.4	1:10.9	102
Rice flour	10.0	6.3	6.7	11.7	58.0	7.3	1:6.5	80
Rice bran	9.7	9.5	10.0	12.1	49.9	8.8	1:5.9	95
Rice hulls	8.2	35.7	13.2	3.6	38.6	0.7	1:11.2	48
Miscellaneous Grains and Seeds and Their Products								
Kafir corn	9.3	1.4	1.5	9.9	74.9	3.0	1:8.3	106
Millet	13.5	9.5	3.0	12.7	58.0	3.3	1:5.3	82
Sunflower seed	8.0	28.5	3.0	13.0	23.9	23.6	1:6.3	105
Broom corn seed	14.1	7.1	2.0	9.6	64.7	3.5	1:7.6	95
Broom corn seed meal	13.5	6.9	2.1	9.7	64.2	3.6	1:7.3	95
Sorghum seed	12.8	2.6	2.1	9.1	70.0	3.6	1:8.6	102
Sorghum seed meal	13.2	1.8	1.6	8.3	71.3	3.8	1:9.2	102
Cottonseed	9.9	22.6	4.7	19.4	23.9	19.5	1:3.5	101
Cottonseed meal	8.2	5.6	7.2	42.3	23.6	13.1	1:1.3	111
Flaxseed	11.8	7.9	3.4	21.7	19.6	35.6	1:5	141
Ground linseed	8.1	7.3	4.7	21.6	27.9	30.4	1:4.8	137
Oil meal—old process	9.2	8.9	5.7	32.9	35.4	7.9	1:1.7	99
Oil meal—new process	10.1	9.5	5.8	33.2	38.4	3.0	1:1.4	91
Hempseed	8.0	14.0	2.0	10.0	45.0	21.0	1:9.7	119
Rapeseed	13.8	10.0	3.9	19.4	10.4	42.5	1:6.3	147
Peas	13.4	6.4	2.4	22.4	52.6	3.0	1:2.4	85
Cowpeas	14.8	4.1	3.2	28.8	55.7	1.4	1:2.8	92
Pea meal	10.3	14.4	2.6	20.2	51.1	1.2	1:2.6	85
Pea bran	11.7	20.1	3.5	16.8	46.2	1.7	1:3	78
Pea feed meal	13.5	7.0	3.1	23.4	51.0	2.0	1:2.4	93
Field beans	15.0	3.2	3.1	20.4	56.7	1.6	1:3	93
Navy beans	12.4	7.2	3.7	22.2	53.1	1.4	1:2.5	90
Soy Beans	10.8	4.8	4.7	34.0	28.8	16.9	1:2.1	117
Soy bean meal	10.4	2.6	5.1	36.0	27.0	18.9	1:2.6	123
Peanut meal	10.7	5.1	4.9	47.6	23.7	8.0	1:1.4	100
Peanut bran	10.5	19.5	5.4	21.8	24.7	18.1	1:3	119
Acorns—fresh	34.7	4.2	1.6	4.4	50.4	4.7	1:4.4	97
Grass and Forage—green								
Grass clippings	76.4	4.1	2.4	2.3	13.8	1.0	1:7	15
White clover	81.5	4.3	2.1	4.4	6.9	0.8	1:1.6	15
Red clover	70.8	8.1	2.1	4.4	13.5	1.1	1:3.7	23
Alfalfa	80.0	4.7	1.7	4.9	7.9	0.7	1:1.9	17
Barley	79.0	7.9	1.8	2.7	8.0	0.6	1:3.5	14
Rye	76.6	7.5	1.7	3.0	10.3	0.9	1:4	18
Corn	82.8	5.0	1.5	1.4	8.9	0.4	1:7	13
Millet	87.0	4.1	1.2	1.3	6.2	0.2	1:5	9
Oat shoots	83.9	3.8	1.5	2.3	8.0	0.5	1:4	14
Rape	85.9	3.5	1.3	2.8	5.7	0.8	1:2.6	12
Buckwheat	83.7	4.3	1.1	2.5	7.8	0.6	1:3.5	14
Mustard	85.1	2.9	1.4	2.9	7.3	0.4	1:2.9	13
Dandelion tops	85.5		0.5	2.5	7.3	0.6	1:3.5	13
Beet tops	90.0		0.1	1.3	2.3	0.3	1:2.3	5
Onion tops	91.0		0.1	0.8	3.0	0.2	1:2.7	8
Lettuce	95.9	0.5	0.8	1.0	1.6	0.2	1:2.1	4
Spinach	92.4	0.7	1.9	2.1	2.4	0.5	1:1.7	6
Cabbage	90.5	1.5	1.4	2.4	3.9	0.4	1:2	8
Hay—dry								
White clover	9.7	24.1	8.3	15.7	39.3	2.9	1:2.9	71
Red clover	15.3	24.8	6.2	12.3	38.1	3.3	1:3.7	67
Alfalfa	8.4	25.0	7.4	14.3	42.7	2.2	1:3.4	71
Timothy	13.2	29.0	4.4	5.9	45.0	2.5	1:8.7	66
Weeds (c)								
Purslane			17.2	26.1	53.7	2.9		
Wild buckwheat			7.5	14.5	75.9	2.1		
Pigweed			9.2	26.5	62.8	1.4		
Lambs-quarters			18.3	25.1	54.6	2.0		
Cheese weed-mallow			10.0	17.7	68.9	3.4		
Catnip			12.0	22.3	63.1	2.7		
Hedge mustard			7.9	16.5	74.2	1.4		

Analyses and Nutritive Values of Articles That Are or May Be Fed to Poultry
(Concluded)

	Water Per cent	Fiber Per cent	Ash Per cent	Protein Per cent	Starches, Sugars, etc. Per cent	Fat Per Cent	Nutritive Ratio	Value (a) Fuel
Weeds (c)—Continued.								
Common mustard			7.1	15.8	75.6	1.6		
Goosefoot			11.5	13.7	74.0	0.9		
Pigeon grass			12.8	16.2	68.8	2.1		
Quack grass			7.7	11.3	79.1	2.0		
Roots								
White potatoes	78.9	0.6	1.0	2.1	17.3	0.1	1:8.3	22
White potatoes—frozen	61.5	0.8	1.1	1.6	34.8	0.1	1:22	42
Sweet potatoes	71.1	1.3	1.0	1.5	24.7	0.4	1:17	31
Table beets	88.5	0.9	1.0	1.5	8.0	0.1	1:5.5	11
Sugar beets	86.5	0.9	0.9	1.8	9.8	0.1	1:5.5	13
Mangel-wurzels	90.0	0.9	1.1	1.4	5.5	0.2	1:4.3	8
Turnips	90.5	1.2	0.8	1.1	6.2	0.2	1:6	8
Carrots	88.6	1.3	1.0	1.1	7.6	0.4	1:7.8	11
Parsnips	81.0	6.3	1.0	1.6	8.5	1.6	1:7.8	15
Onions	87.6	0.7	0.6	1.4	9.4	0.3	1:7.2	13
Dry-beet pulp	8.1	19.8	2.7	10.2	58.4	0.8	1:6	82
Fruits (d)								
Apples—fresh	84.1	0.9	0.2	0.2	14.3	0.3	1:15	17
Apple pomace	80.2	4.5	0.7	0.9	13.2	0.7	1:16	18
Apple pomace—dry	10.0	20.5	4.0	3.2	59.1	3.2	1:21	91
Pears	80.9	1.5	0.4	1.0	15.7	0.5		10
Peaches	89.4	3.6	0.4	0.7	5.8	0.1		12
Plums	78.4		0.5	1.0	20.1			24
Cherries	80.9	0.2	0.6	1.0	16.5	0.8		23
Grapes	77.4	4.3	0.5	1.3	14.5	1.6		28
Bananas	75.3	1.0	0.8	1.3	21.0	0.6		29
Blackberries	86.3	2.5	0.5	1.3	8.4	1.0		17
Cranberries	88.9	1.5	0.2	0.4	8.4	0.6		13
Currants	85.0		0.7	1.5	12.8			17
Gooseberries	85.6		0.3	1.0	13.1			16
Huckleberries	81.9		0.3	0.6	16.6	0.6		22
Raspberries—red	85.8	2.9	0.6	1.0	9.7			16
Raspberries—black	84.1	2.9	0.6	1.7	12.6	1.0		20
Strawberries	90.4	1.4	0.6	1.0	6.0	0.6		11
Watermelon	92.4		0.3	0.4	6.7	0.2		9
Muskmelon	89.5	2.1	0.6	0.6	7.2			11
Cucumbers	96.0	0.7	0.5	0.8	1.8	0.2	1:2.8	3
Tomatoes	91.3	0.7	0.7	1.0	5.8	0.5	1:7	9
Pumpkin-flesh	93.5	1.0	0.6	0.9	3.9	0.1	1:4.6	6
Pumpkin seeds and stringy part	76.9	3.9	1.5	6.0	4.8	6.9	1:2	31
Animal products								
Meat scrap	1.3		8.0	58.0		32.9	1:1.4	154
Pork scrap	0.8		2.2	57.4		39.6	1:1.7	170
Dried blood	6.7		6.6	65.1	5.3	16.3	1:0.6	124
Green bone	6.9	2.2	24.5	22.3		16.5	1:1.8	69
Fish scrap				34.0		6.5	1:0.4	56
Whole milk	87.2		0.7	3.5	4.8	3.7	1:4	18
Skim milk—raised	90.4			3.1	4.7	0.8	1:2	11
Skim milk—separated	90.6			2.9	5.2	0.3	1:2	10
Buttermilk	90.1			3.9	4.0	1.0	1:1.6	11
Milk albumin	24.8	3.5	3.9	13.9	50.9	3.0	1:4.4	83
Cheese	34.4		3.4	23.7	1.7	36.9	1:4	107
Whey	93.8		0.4	0.6	5.1	0.1	1:8.5	7

To Find the Values of Feed Mixtures

In computing the values of possible mixtures of feeds from the accompanying table it is more convenient to make estimates on mixtures containing 100 pounds, or simple multiples and fractions of 100 pounds of each article used. When this is done the percentage figures in the table give the amount of each element in 100 pounds, and the amounts for multiples or fractions of 100 pounds can be written from the table with mental calculation. Thus in the table it is stated that corn contains 10.4 per cent protein, 70.3 per cent carbohydrates, and 5 per cent fat; and that wheat contains 11.9 per cent protein, 71.9 per cent carbohydrates, and 2.1 per cent fat. We can calculate at sight that in 100 pounds of corn there are 10.4 pounds of protein, 70.3 pounds of carbohydrates and 2.1 pounds of fat. And in the same way we can read off the value in 100 pounds of wheat.

Suppose now we want to get the nutritive ratio of a mixture of equal parts of corn and wheat. Using 100 pounds of each in the calculation we have:

	Protein	Carbohy's.	Fat
Corn	10.4 lbs.	70.3 lbs.	5.0 lbs.
Wheat	11.9 lbs.	71.9 lbs.	2.1 lbs.
	22.3 lbs.	142.2 lbs.	7.1 lbs.

The nutritive ratio of the mixture is 22.3: (142.2†7.1x2.25) or
22.3: 158.2 equals 1:7.1.

In this case the result could have been reached by the simple process of taking the mean of the nutritive ratios, but in general that is not practical.

To calculate the fuel value of a mixture, we simply reduce the pounds to ounces, multiply the total ounces of protein and carbohydrates by 116, the ounces of fat by 264, add the two results, which gives us the total heat value of the whole amount; and then find the heat value in one ounce of the mixture. This is the process for exact calculations, and for rations with many ingredients in varying amounts. In ordinary practice, if the amounts of articles used are in multiples of 100 lbs., the heat value can be determined with sufficient accuracy by adding the heat values for one ounce of each hundred pounds in the mixture, and dividing the sum by the number of hundreds of pounds. Thus in a mixture of 100 pounds each of corn, wheat and oats, the sum of the heat values of an ounce of each is 304, and the heat value of an ounce of the mixture is found by dividing 304 by 3, which gives us 101 plus. In case we have 200 pounds of corn in such a mixture, we can simply consider each 100 pounds of corn as a separate item, making four items in all. Then the sum of the heat values of an ounce of each article in the mixture is 410, and the heat value of one ounce is 102.5.

Digestion Coefficients

In scientific experiments in feeding, account sometimes is taken of the actual digestibility of the several elements which are called "digestible nutrients" but which are, in fact, rarely completely digested, and which under some conditions are very imperfectly digested. The percentage of digestibility observed is called the "Coefficient of Digestibility." The method of using this is to assume that the proportion of an element in a feed found to be digested in a certain case or in the average of a number of cases, represents the amount of the element that is actually digestible. That is if the protein in corn is 72 per cent digestible, while the carbohydrates are 95 per cent, and the fat 89 per cent, the percentages in the table do not represent actual feeding values, but these must be determined by applying the coefficients of digestibility.

The appropriateness of this in scientific work where the values of the feeds used can be determined by laboratory methods, and the results analyzed and checked in the same way, is obvious. But to show the impracticability of applying the digestion coefficients in ordinary feeding practice it is only necessary to state that while the average digestibility of corn in a certain report including twenty-three investigations was 72 per cent, the range of digestibility in these investigations was from 58 to 84 per cent. Further, with regard to the application of digestibility coefficients to poultry feeding it should be understood that little has been done toward determining them for poultry, and no one knows to what extent those worked out with other animals will apply to poultry. As the reader who may take an interest in the science of feeding that will lead him to take note of discussions of it elsewhere will find that in some cases much importance is attached to the use of coefficients of digestibility in determining the values of rations, it seems advisable to state here the limitations on their use, and especially on their application to poultry feeding.

Notes On The Table

(a) In calories per ounce. A calorie is the amount of heat required to raise the temperature of one gram of water one degree centigrade.

(b) Including fiber.

(c) The analyses of weeds here given are taken from Bulletin 101, of the Minnesota Experiment Station. As they were made from weeds in dry hay, and the percentages are for dry matter, not for the whole as in most analyses in this table, it has been thought best not to undertake further to express their values, especially as poultry eat them only in the tender green state. The great interest of these analyses is the high percentage of protein in some of the common weeds. Looking at these figures it is easy to see why poultry that can eat freely of these common succulent weeds in warm weather thrive amazingly.

(d) As these analyses are taken from bulletins on human food and the figures are not fully given, I have not attempted to give the nutritive ratios, that were not given in the sources from which they were obtained.

CHAPTER III

Principles, Methods and Systems of Feeding

Adapting Rations to Conditions—Development of Feeding Formulas—Energy Value the Best Measure of Feeding Value—Importance of Variety in Grain Diet—Moist and Dry Mash Systems Compared—Combination of the Good Features of Both the Best Practice—Relation of Range and Exercise to Feeding Methods.

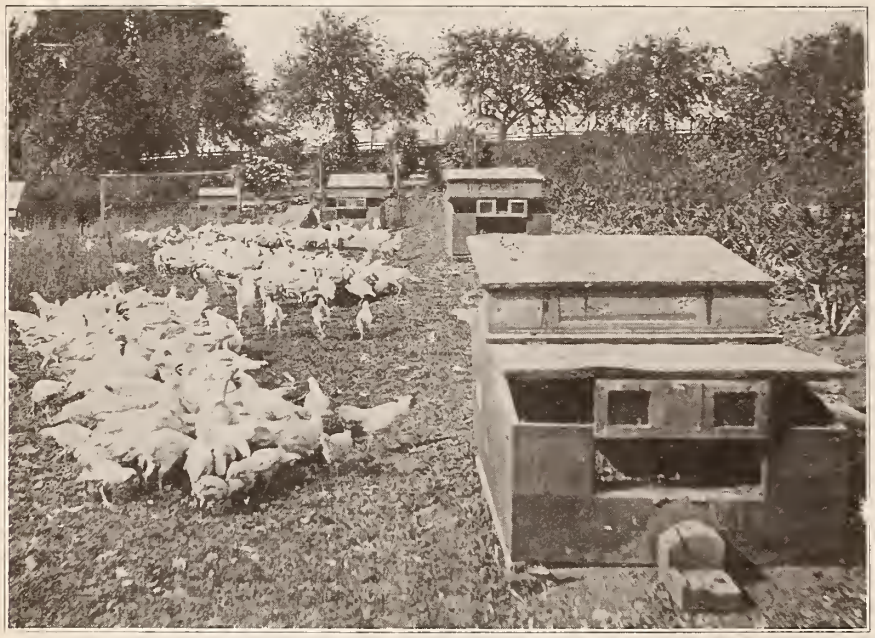
IN the preceding chapters the nutritive requirements of poultry and the sources of supply to meet these requirements were discussed. In this chapter we have to consider the details of making these supplies available, and of getting both efficiency and economy in feeding. As has been stated, feeding the common grains and their straight products to poultry is a simple matter. So in a study of the principles of feeding,—in fact, in an initial determination of the principles of poultry feeding, we begin with observation of the results of feeding a simple ration of common grains and their well-known by-products.

How Rations Are Adapted to Conditions

In comparing results of feeding common grains, no such differences in their feeding values can be found, as many claiming to write with authority on this subject assert exists. It is not true that hens or other poultry fed exclusively on corn would starve to death because of a lack of protein for, as the reader may see by referring to the table on page 23, corn contains a large amount of protein, and as a matter of fact some corn contains much more protein than some wheat and other grains which commonly average higher in this nutrient. As far as is known, corn contains ample supplies of protein for the ordinary growth and maintenance of poultry, and the objection to using good corn or corn products exclusively or too freely (for the purpose in feeding) is not a lack of protein but an excess of fat. If the accumulation of fat is not objectionable or detrimental, or if the fat in the corn is all used to provide heat and energy, the amount supplied is not only an advantage, but if the fat were not obtained from corn it would have to be provided from some other source, possibly at much higher cost and by special effort.

Further, as the first requirement of the body is to maintain itself at a normal temperature, and the processes of growth and production can go on only at such temperature, in cold weather poultry may not be able to get all the heat they need from the carbohydrates and the fat in corn. What happens then is that the protein in the feed is used for heat production, and while protein has peculiar value as a flesh former, as fuel it has only as much value as the carbohydrates, and less than half the value of fat.

By comparing the analyses of the different common grains as given in the table the reader will see that they are quite similar in their protein and carbohydrate contents, and that in general they contain about six or seven times as much carbohydrates as protein. The variation in fats is greater, but with respect to this they fall into two groups: wheat, barley, and rye approximate 2% of fat, which is about one-sixth to one-fifth of the protein, and about one-thirtieth of their carbohydrates; corn and oats have 5% of fat, which in corn is one-half and in oats about two-fifths of the protein; and in corn one-fourteenth, and in oats one-twelfth of the carbohydrates.



BROODER CHICKS AT BREAKFAST

Note these brooders placed at the side of a berry patch, which afford shade and some feed. Observe, too, that the grass while worn close near the brooders, is fairly long at a little distance. A range in good condition for chickens should be growing something else at the same time.

The comparison of results of feeding corn and wheat is the best to make in getting at the principles of feeding because, while the birds have some preference for corn, they eat wheat just as freely when fed on it alone, while with all the other grains the tendency is to eat light. In feeding corn and wheat separately, each being the principal part of the diet, it is found that sometimes one is the better feed, sometimes the other, and by taking into consideration the conditions affecting bodily requirements, and the effects of feeding, it becomes easy to determine how far either grain will meet requirements or serve the purposes of production under any given conditions in practice.

Where fowls are confined and fed on grain, with only enough green feed to keep them in condition—not enough to make any substantial part of the ration—wheat will be found to answer all the requirements of maintenance and of heavy egg production when temperatures are moderate as in spring, fall, and cool summer weather. Under

BROODER CHICKS IN GRASSY YARDS—A GENERAL VIEW AT GRANDVIEW FARM, AURORA, N. Y.
Note the colony houses for older chicks in the distance.

the same conditions the feeding of corn exclusively may give heavier egg production in hens that do not readily put on fat, but eventually is likely to lead to some accumulation of fat, which is beneficial as long as it does not become excessive, but detrimental as soon as it begins to hinder activity and vital functions.

In colder weather, or even in a colder house, or a more exposed locality, corn may simply meet the maintenance and production requirements, while wheat being lower in fats is deficient. Taking the percentages in round numbers for convenience of comparison, we can see that if a ration of corn containing 10 per cent of protein, 70 per cent of carbohydrates, and 5 per cent of fat is a suitable ration at a particular time, and under certain conditions, then a ration of wheat containing 12 per cent of protein, 72 per cent of carbohydrates, and 2 per cent of fat will be deficient in carbohydrates and fats, and the deficiency must then be made up by taking a part of the protein to supply heat and energy. What would happen in the supposed case is this:

Fat has two and one-fourth times the capacity to produce heat that carbohydrates and protein have. Hence the carbohydrates and fat in corn in this instance are equal to 82 per cent of carbohydrates; and the proportion of protein to carbohydrates required is 10 to 82. In wheat the total carbohydrates and fat is equivalent to only 77 per cent of carbohydrates. There is a deficiency of five per cent in the feed elements of this class needed. It is made up by taking five per cent out of the protein elements and using it as "fuel." This leaves only 7 per cent of protein available for maintenance, growth, or production, against 10 per cent in corn. That is, in the case and under the conditions supposed, corn is nearly fifty per cent more efficient than wheat for such service as the feed performs after providing heat and energy.

This does not mean that if wheat is at any time an insufficient feed corn should be substituted. The question of the principal grain to use is a matter of availability and cost. The base of the ration should be the most abundant and cheapest grain. In case that is wheat, and particularly in sections where wheat is extensively grown and corn is not, the deficiency of heat-making elements may be made up, and the full value of the flesh makers in the wheat conserved, by the use of any article of feed which will supply what carbohydrates and fats are lacking. By giving an amount of meat scrap which would supply fat equivalent to five per cent of carbohydrates the deficiency would be met, and at the same time the protein would be increased something over one percent, or a little over one-twelfth of its actual amount. Whether this addition to the protein was useful and economical would depend entirely upon whether it was needed and could be used for flesh forming or in egg production. In general it is only in periods of growth, molting, and heavy egg production that there is any advantage in supplying more protein than is contained in the ordinary grains.

In case corn appeared insufficient for a ration, and that would be the case in extreme cold weather, the addition of meat scrap would supply the deficiency, and a very little meat scrap might make the fats and carbohydrates sufficient and at the same time add substantially to the protein in the ration and to the results to which protein contributes. So in cold weather poultry that are growing, laying, or molting can be fed rations rich in fats and carbohydrates without becoming overfat, while poultry that require only a maintenance ration will keep in good condition upon corn alone. In this case they no doubt use much of the protein in the corn for heat forming, but as the corn is generally the cheapest feed obtainable, the protein contained in it costs no more than the other elements, while the protein contained in meat scrap is more expensive; that is, where extra protein has to be supplied it usually costs more than what is obtained in the common form in staple feeds.

In extremely hot weather all grains may be too heating, and corn being the most heating is then of course, the least suitable to feed by itself. But as in cold weather we can supplement the deficiency of heat-forming material in grain by feeding meat scraps which are much richer in

BARRED AND WHITE PLYMOUTH ROCK CHICKENS ON DOMINION EXPERIMENTAL FARM, OTTAWA, CANADA
Thrifty chickens showing good condition and good care and feeding.

TYPICAL HOUSE USED IN THE COLONY POULTRY FARMING DISTRICT OF RHODE ISLAND

fats, so in hot weather we can reduce the heating effects of grains by feeding more freely of bulky, succulent, and fluid, or semi-fluid feeds, and with an ample supply of these it may still be entirely practical to continue to feed corn without any other grain. In fact, whatever grain is fed in extremely hot weather, the heating effects must be counteracted in the way described, and under such conditions the grain having the least fat and starch gives best results when, as is commonly the case with poultry on limited range or in confinement, the supply of light, cooling, succulent feeds is not as liberal as it should be to properly balance a hearty grain ration.

While it is possible—as has been shown—to use a ration containing only one kind of grain, and to use any kind of common grain in that way if the quality of the article fed is such that poultry will eat it freely (and the explanation of how it can be done gives us the simplest case of balancing rations), in good feeding practice there is always more or less variety in good rations. For this variety there are two equally good general reasons: poultry like variety, and the economical use of low grade and waste feeds requires that they be fed a variety. Hence, in practical feeding, we have to deal not with the common grains which as they grow contain and supply the principal nutritive elements in about the proportions that they are required by men, animals, and birds under average conditions of temperature and other matters affecting nutritive requirements, but with mixtures of these grains in numerous combinations. The principles upon which we work in adjusting rations to different conditions and for different purposes, however, are the same in all cases.

For the conditions in which corn would supply all the nutritive elements in their proper proportions, it is obvious that a ration that supplied the same elements in the same proportions would be the suitable ration. It is also plain that for conditions requiring more heat elements than corn supplies, the mixed ration would have to be made more heating by the addition of similar elements; and that where a corn ration was too heating, that particular mixed ration would also be too heating. The principle upon which we proceed in making mixed rations is most easily illustrated by taking the case where a corn ration is too heating, or too fattening, and there is not succulent feed or milk available to the amount that is necessary properly to reduce the corn ration. The desired result is then obtained by substituting for a part of the corn as much of a grain containing less carbonaceous matter as is necessary to give the poultry what protein they need without giving them more heat-producing elements than is good for them, or suitable for the purpose for which they are being fed.

A FIELD IN WHICH COLONY POULTRY HOUSES LIKE THE ABOVE, AND OF SIMILAR TYPES ARE DISTRIBUTED

It is very difficult to get photographs of separate small houses that give a good idea of the looks of a field containing many of them. At a distance the contrasts in the buildings, land and stone walls are not strong enough to show the buildings well.

SKIDS ATTACHED TO FRONT GEAR OF A WAGON—FOR MOVING COLONY HOUSES

The gable roof building is a cook and feed room.

DEVELOPMENT OF FEEDING FORMULAS

In discussing feeding matters nowadays we do so with an understanding of the chemical constituents of different feeds, and of the proportions in which they should be combined for various purposes. As a matter of fact, however, standard mashes of straight ground products of corn and oats, and of the by-products of wheat flour, and the common mixtures of the staple grains used in poultry feeding were all worked out in the practice of poultry keepers before chemists had made the studies of feeding which now enable us to understand the reasons for what is done, and to use a greater degree of intelligence in adding new by-products and feeds to rations.

When poultrymen began to pay some attention to the scientific aspects of the subject, there was more or less confusion and error in applying to poultry feeding the principles and formulas worked out by scientists in the

LARGE COLONY HOUSE, COOK AND FEED HOUSE, AND DOUGH CART ON RHODE ISLAND POULTRY FARM

The cook house is built to drive the cart through to load.

feeding of other animals. They soon discovered that the foundation of the science of poultry feeding was in the practice of the best poultrymen. The fact that a ration adjusted by careful trials in practice to get certain results did produce those results, showed that it was a properly compounded ration.

When the rations used at that time by the best poultrymen were analyzed and their values computed according to the proportions of the different nutritive elements each contained, it was found that the most efficient grain and meat rations for growing stock and for heavy egg production had very nearly the same proportions of protein to carbonaceous elements that is found in wheat, barley, and rye. The average for a number of good rations computed by the writer at that time was precisely the same as for barley. As computations of this kind do not take into account the green feed consumed, which in ordinary practice cannot be measured or weighed with sufficient accuracy to include its values in the computation of the rations used, they are not scientifically accurate, yet they are sufficiently so for common use. Before describing the method of making such computations it is necessary to explain the common scientific terms used in dealing with feeding and with feed values.

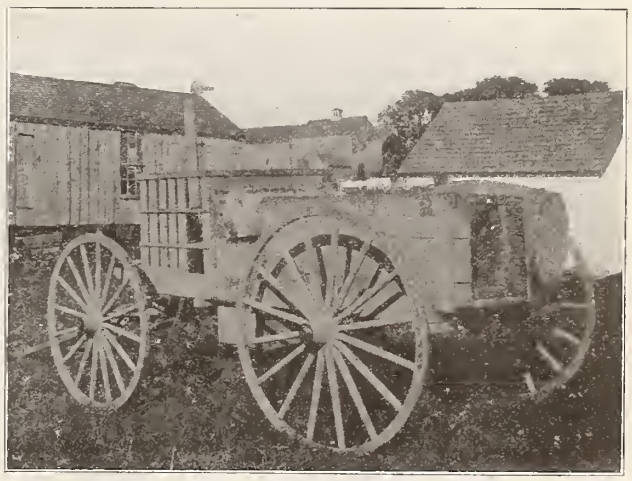
It has been shown that the common grains, and the mixed rations as worked out by the best practical poultrymen before the days of scientific study of poultry feeding, contain the relative proportions of protein and of carbonaceous materials which poultry require under average, ordinary conditions, and that with variations from those conditions, or to secure extraordinary results, the relative proportions of the different classes of feed elements are increased or diminished as the case requires. This relation between protein or flesh-forming elements, and carbohydrates and fats (the heat and energy producing elements), reduced to terms of carbobydrates by multiplying by 2.25 is called the nutritive ratio, or nutrient ratio.

PERHAPS THE MOST POPULAR STYLE OF CART IN THE LITTLE COMPTON COLONY POULTRY FARMING DISTRICT

The low platform makes it easy for the feeder. The barrel and box are movable, and the cart can be used for many purposes besides feeding.

Each natural whole article of feed has a nutritive ratio which is constant to all intents and purposes of practical feeding. In the straight mill products of grains the ratio is also constant, but in by-products of variable composition it also is variable, of course, and that is why the necessity arose for official inspection and analysis of such products. In mixtures of any number of ingredients, the nutritive ratio for the mixture is computed by first computing the total amount of each of the principal feed elements contained in it and then finding the ratio of the protein to the carbonaceous matter, the fat being reckoned at two and one-fourth times the value of the carbohydrates.

For simplicity and convenience of comparison, nutritive ratios are commonly expressed in their lowest terms, and as the term representing the protein is always the smaller one, the protein is always represented by 1. An article or mixture in which the difference in the numerical values of the terms representing the relation of its protein to its carbonaceous elements is small is said to have a narrow nutritive ratio. One in which the difference is relatively great is said to have a wide nutritive ratio. An article, mixture, or ration having a narrow nutritive ratio is therefore a relatively highly nitrogenous feed, while one having a wide ratio is relatively a highly carbonaceous feed. To make a ration narrower is to increase the amount and proportion of its protein; to make it wider is to increase the amount and proportion of its carbohydrates or fats, or both.



THE DOUGH CART SEEN IN UPPER PICTURE

This cart has the mash box and water barrel accessible at the tail, a deep box for grain in the middle of the frame, and a coop for moving chickens in front—a complete equipment.

Early investigators and students of feeding subjects generally regarded the nutritive ratio as the best measure of value of a feed. On the assumption that flesh-forming elements were more essential they reasoned that the higher the proportion of these an article contained the greater was its feeding value, and if they did not expressly state it, their statements still conveyed to most persons not versed in the science the impression that the more protein in the feed the better the results would be. It was customary to compute the values of feeds in terms of the heat units they contained and to give these with the nutritive ratios, but the fuel value, or potential energy,

as it is called, was for a long time regarded as having no special significance in relation to feed values in nutrition.

After a time, however, it was noted in observations and comparisons of rations that the results seemed to follow potential energy values more closely than they did nutritive ratios. Two articles or rations having the same nutritive ratio might not give the same results in feeding,

A TWO-WHEELED CART ESPECIALLY FOR WATER
This was used on the farm of P. R. Park when he was popularizing dry feeding. Only water had to be distributed daily.

but two articles or rations having the same potential energy would usually appear to be much the same in feeding value. The most important practical result of this observation was to give a better appreciation of the value of the carbonaceous elements in feeds, and to emphasize the fact that while protein is the substantial structural element, the efficient and economical use of it depends upon the supply of carbonaceous material being so ample for every requirement of heat and energy that the organism can function perfectly without using protein for any other than its special purpose. The reason that the nutritive ratio is of no value as a measure of the value of a feed or ration is plain when we consider that it is merely an expression of the relative amounts of the two classes of nutrients in the article, while the potential energy is the actual sum of the values of all the nutrients in a specific amount (one pound or one ounce) of the feed for the purpose for which the carbonaceous elements are used, and for which the protein will be used should the special heat and energy-producing elements be at any time insufficient for their special service.

Comparison of the potential energy values of feeds is therefore a serviceable method of determining their relative feeding values, though neither that or any other single principle can be taken as an always reliable guide, for it will be found again and again that things which by a certain standard of comparison appear of nearly equal value actually have very different values and effects in feeding. This sometimes is plainly due to the presence in the feed of unpalatable, non-nutritious elements, which are not included in computations of values of the nutrients in it though they appear in a statement of its analysis, and their presence affects the palatability as well as the nutritive value of an article.

The relations of other elements in feeds, and especially of water and fiber, which are sometimes present in large quantities, is best explained and illustrated by a few comparisons of articles mentioned in the table on pages 23 to 25. Buckwheat and tomatoes have the same nutritive ratio—1:7, but buckwheat has a potential energy of 83 heat units per ounce, while tomatoes have a potential energy of only 9 heat units per ounce: that is, an ounce of buckwheat will provide more than nine times the heat and energy that an ounce of tomatoes will. The difference is due to the fact that tomatoes are more than nine-tenths water, while buckwheat is only one-eighth water.

Green grass clippings have the same nutritive ratio, 1:7, but there are 15 heat units in an ounce of green grass, sixty per cent more than in tomatoes, because grass contains less water and correspondingly more of solid nutritive elements. Lettuce and buckwheat middlings have the same nutritive ratio, 1:2.1, but lettuce with a potential energy of 4 provides only one-twenty-fifth as much heat and energy as buckwheat middlings with a potential energy of 101. Lettuce is 95.9% water, buckwheat middlings, 13.2%. Lettuce and cucumbers are the lightest and most cooling of all vegetable feeds, hence their popularity with both people and poultry to offset the effects of heavy grain and meat diets.

Corn meal and timothy hay have nearly the same nutritive ratio; corn meal 1:8.5, and timothy 1:8.7. The relation of their nutrients is practically the same, but corn meal has a potential energy of 100, while timothy has a potential energy of only 66, and corn meal is a palatable feed, capable of sustaining life, growth, and production for considerable periods, while timothy hay is practically worthless for poultry. Here the conspicuous difference is in the structure of the articles and in the relative amounts of indigestible fiber. Corn meal has only 1.9 per cent of fiber, timothy hay has 29 per cent. We can see at a glance also, in comparing potential energies of these articles, that even if the fiber could be removed from timothy hay and the digestible nutrients fed to poultry, they would have to consume relatively large quantities of it to give the results obtained by concentrated feeds, and their digestive organs generally have not the capacity for doing this.

Poultry will eat fibrous feeds freely only in the green state, or, as in case of alfalfa and clover especially cured for poultry, when cured in the green state. The grains which are most palatable to them are those which contain from about 2 to 3 per cent of fiber. Knowing this, and usually having had opportunity to observe the indifference of poultry to a grain with as much fiber as even the best oats, when they have a choice between that and a smooth grain, the poultry feeder can tell at a glance at

TWO WHEELED CART FOR BOTH FEED AND WATER
USED ON A RHODE ISLAND FARM

the analysis of a grain with the feeding properties of which he is not familiar, whether the amount of fiber in it is so large that it will not make a satisfactory feed for a staple. Also in considering waste products containing large amounts of fiber he can judge at sight of the statement of the fiber in a feed whether that element is present in excessive quantity.

A feed containing a large amount of fiber and also rich in protein or fat might be a serviceable feed, if the addition of small or moderate quantities of it to a feed lacking in fat or in protein would supply the deficiency without unduly increasing the amount of fiber in the whole ration. But if in order to supply the required amount of digestible nutrients, the amount of fiber is increased to an extent that makes the mixture unpalatable to the birds, the effect may be to decrease the consumption of feed to such an extent that the total nutrients eaten is less than it was before.

What science can teach us of feeding is of great service when intelligently used in connection with ordinary observation and practical experience. The final test of the value of any feed or combination of feeds is the results obtained both in production of flesh, eggs, and feathers, and in keeping the poultry healthy and thrifty. To a limited extent we can secure quite free consumption of feeds that are not the most attractive to poultry by withholding more attractive feeds that are not so available, or sometimes by accustoming the poultry to a ration in which the—to them—more desirable article appears only at intervals as an extra. Details as to this will be given farther on. As far as they harmonize with results obtained in practice, scientific methods of estimating values are useful. Where a lack of harmony appears, it is either because the observation of the poultryman or the formula of the scientist is inadequate and gives occasion for some error. We cannot look for perfection in either phase of the study of feeding questions.

Since investigators of matters relating to nutrition discarded the idea that rations should be compounded with the view to making them exactly meet the requirements of the animal, the compounding and balancing of rations has been placed on a much simpler, more practical, and more successful basis. Persons who are well-informed on the subject no longer regard science in feeding as a means of exactly adjusting the supplies of different kinds of nutrients to the requirements of an organism—mammal or bird. They recognize rather that only the larger adjustments in rations can be made by the feeder, and that the minor adjustments must be left to nature—to the instincts and appetites of the birds, and to the capacity of the system to convert surplus nutritive matter in excess of its immediate requirements into a reserve stored in the body for future emergencies.

In accordance with this general principle it is usual now in feeding practice to make the grain rations to suit the requirements of growing stock and of laying and breeding stock for conditions existing during the greater part of the season or of the year, and then to modify them as necessary for wide changes in conditions, doing this partly through variations in the amounts of one or more of the principal constituents of the grain ration, and partly by increasing or decreasing meat products or green feeds, as the conditions require. The mode of procedure in this respect was briefly described on pages 27-8, and will be treated more in detail in the discussion of particular rations and of methods of feeding.

The Question of Variety in Grain

It has been shown, and the fact emphasized, that our common grains are nearly the same in composition, as regards the principal nutrients, and that they have the nutrients in proportions near the average requirements of poultry for maintenance and moderate growth and production. Scientific students of feeding tell us that it makes no difference to the omnivorous animal organism whether its supplies of flesh formers and heat and energy producers come from animal or vegetable substances—from one feed or another. The main thing is that they shall be in sufficient supply. The elements as obtained from some feeds seem to be more easily or more fully digestible than as obtained from others, but as they are 100 per cent digestible in comparatively few cases, this is merely a matter of slightly different degrees of digestibility in feeds.

But while theoretically, and practically for short periods, animals may live on nutrients from a single feed, it needs but a little experience in the feeding of animals of any kind to show that they will not thrive without a variety of feed, and in feeding poultry one quickly learns that they not only want variety in the way of properly balanced supplies of the different classes of feeds—grains, animal feeds, and vegetable feeds, but that in each of these they prefer some variety, and that they thrive best and are most productive when the feeder caters a little bit to their appetites. This is a matter to which neither the ordinary farm poultry keeper, nor the back-yard poultry-keeper whose table waste constitutes an important part of the feed of a few hens, needs to give particular thought. In both of those cases, a considerable variety is incidental to the conditions. But where a farm is heavily stocked with poultry, or a city flock is so large that the waste from the family table is but an insignificant part of the ration, the question of providing a reasonable amount of variety in feed and doing so economically, becomes one of considerable importance.

The student of poultry feeding can best appreciate the occasion for feeding a variety to poultry, and the possibilities of making variety from a limited number of articles, if he considers the similarity in tastes between people and poultry, and the ways and means adopted in domestic economy for varying a simple diet. The good cook makes a great variety of things by cooking a few staple foods in different ways, and by varying the com-

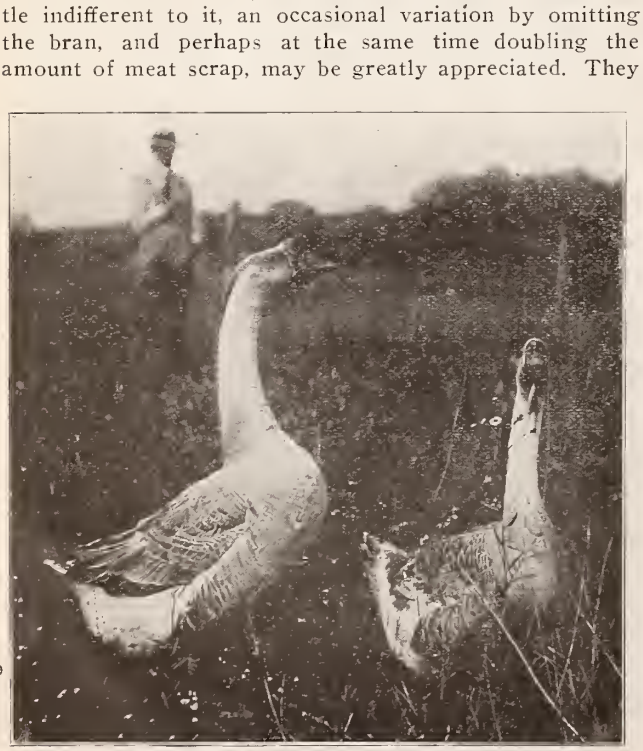
LOW WHEELED FEEDING AND WATERING CART USED AT AUSTIN GOOSE FATTENING FARM, MANSFIELD, MASSACHUSETTS

binations. In the same way, though by cruder processes and with narrower limits imposed by the need of always making a profit, the good poultry feeder gives to the rations he feeds enough variety to keep the birds' appetites keen, and to secure the largest consumption of feed by each bird that it can digest and assimilate, and from which it can turn out a profitable commodity while still keeping itself in good condition for further service.

The poultry keeper who grows his grain, or who buys and mixes his own feeds needs to consider the question of variety in grains much more than the one who buys ready-mixed feeds. As has been stated, the manufacturer of commercial mixed feeds makes a point of securing good variety both in his mash mixtures and his scratch mixtures. He is so diligent in getting every sort of grain, seed, or mill by-product that will give appetizing variety to the feeds he sells that he almost monopolizes the accessible supplies. And as the grains the poultryman grows or buys in quantity are few in number, he must give particular attention to the matter of feeding them in different ways, and also must be more careful to supply variety in the other classes of poultry feeds.

EMDEN GOOSE AT HER NEST

In mashes of mixed mill stuffs, variety can be obtained by occasionally making the mash different in composition. Thus if the moist mash usually fed is a mixture of corn meal, ground oats, and wheat bran in equal parts, with 5 per cent of meat scrap, and the birds begin to seem a little indifferent to it, an occasional variation by omitting the bran, and perhaps at the same time doubling the amount of meat scrap, may be greatly appreciated. They will not eat as much, as a rule, of the richer mash, but they will relish it more; and while it would not be a good mash for continuous feeding, using it occasionally varies the monotony of the uniform mash with always the same ingredients in the same proportions. In making such variations the feeder must use judgment of course, taking into consideration the condition of the birds and also temperature conditions. The variation mentioned by way of illustration would not be right for hens that were becoming fat, nor would it be appropriate in extreme warm weather. Either of these conditions would call for reducing heating elements.



A PAIR OF AFRICAN GEESE AT THE RHODE ISLAND EXPERIMENT STATION

Raw or Cooked Feeds

Until some fifteen years ago facilities for cooking a part of the feed for poultry were regarded as a necessary part of the equipment of an up-to-date plant for the production of fowls and eggs, while the small poultry keeper who did not have stock enough to warrant special appliances for cooking for the poultry relied upon a big pot on the kitchen stove. The cooking of feed for poultry was sometimes overdone in the old days. People did too much of it, and made too much work of what they did. But of late years the tendency is to go to the other extreme, and rigid adherence to systems that do not call for regular cooking leads to neglect to provide even such facilities for cooking poultry feed as are almost essential if the poultry keeper is to be prepared to use all available wastes to the best advantage.

The economical use of such things as small potatoes, beets, carrots, and turnips for poultry, requires that they

FLOCK OF BREEDING GEESE—MIXED BREEDS—AS COMMONLY USED IN GOOSE GROWING DISTRICTS

This flock produced from four to five hundred goslings a year. Nearly all their feed was obtained from the pasture.

be either cooked or cut fine in a root cutter. We can fasten large roots in poultry houses so that the poultry can pick them to pieces, but with small roots this cannot be done, and if they are given without cutting they are under the fowls' feet, rubbed in the dirt of the floor, and soon become so soiled that the birds have to be famishing for succulent feed or they will not eat them. Cut in a root cutter and fed raw, there is less waste but it still is considerable, as the birds pick the stuff over and scatter it more or less. Cooked until soft, and then mixed with meal and bran, and a little meat meal to flavor it more highly, such waste roots make a mash that the birds greatly prefer to any raw mash, and the full feeding value of the roots is secured.

Onions which are much relished in any form by poultry, and generally considered very beneficial, cannot be fed raw to laying hens, or to poultry from which birds are being taken to kill for the table, because raw onions

give their flavor to both the flesh and the eggs. But cooked onions may be fed as freely as desired without imparting any undesirable flavor. Oats of such inferior quality that poultry will not eat much of them raw, will be eaten with relish when boiled, or even thoroughly soaked in warm water. Meat that is slightly tainted, as waste meat scraps often are, is not a good feed for poultry. Though they will eat it freely, and some may not be injured by it, there are many birds that are especially susceptible, particularly birds kept in rather close confinement and fed on heavy rations. Thorough cooking of such meat greatly reduces, if it does not entirely eliminate the danger in feeding it.

SYSTEMS OF POULTRY FEEDING

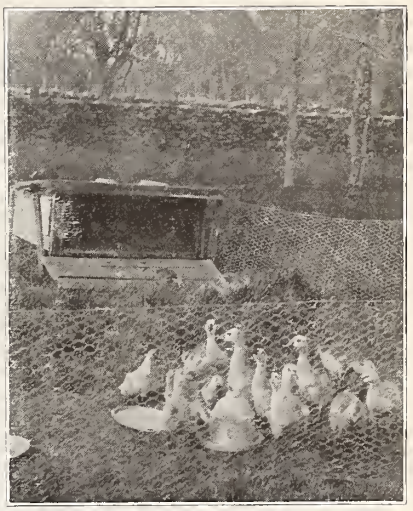
IN feeding poultry two general systems are in use, the differences between them being made by adjustment in each to suit the method of feeding the mash, which in one case is fed moist, and in the other dry. While some poultry keepers rigidly follow either one system or the other, that is not generally the best practice. The best results are obtained by combining some features of the two. Before discussing typical suitable combinations we will consider these two systems separately, taking the older system first.

In the moist mash system of feeding, the ground feeds given are mixed with water or milk, and fed at a regular time daily, the amount given at that time being usually carefully adjusted to the appetites of the birds, the idea being to give only as much as they will clean up in a period of twenty to thirty minutes, or occasionally a longer period. The hard grains used are also generally given at particular times, and in such amounts as will be eaten before the next feeding. In this system as usually applied, the aim is to feed well, yet never so much that the birds will not have good appetites for the next meal. The meat is usually fed in the mash, and the vegetable feed partly in the mash and partly in other forms.

In the dry mash system the ground feeds, including meat scrap or other ground meat preparations, are fed dry in hoppers, which are either accessible to the birds at all times, or are open for quite a long time daily—several hours or more. The grains are usually fed in the same manner as in the other system, but with less attention to regularity in time of feeding when the dry mash is accessible at all times. Fine clover or alfalfa meal is given in the mash, but all other vegetable feeds must be given separately.

Dry Mash Feeding

The system of dry mash feeding was developed to avoid certain common troubles in the use of moist mashes. The making of a good moist mash is not a difficult thing, but if it is not done with due care to secure proper consistency in the mixture and to have it appetizing to the birds, the results are very unsatisfactory. Either they do not eat it well, or indigestion and bowel troubles develop. By giving the mash dry the ill effects of improperly made moist mashes are avoided, but the good results of using properly made moist mashes are not secured unless the feeding of dry mash is supplemented by special provision to insure abundance of succulent feed, which becomes of even more importance in dry feeding than when the moist mash is used. Fowls fed on a dry mash must either drink more water or have a great deal more succulent feed. Poultry do not like a dry mash as well as a properly made moist mash, and will not eat it as readily when the dry mash contains the same proportion of animal matter that is usually fed in a moist mash. To make a dry mash appetizing to them, the meat scrap, fish scrap, or similar substance must be considerably increased. This can be done with safety and with generally good results if the birds are allowed to balance their own rations of dry mash and hard grain—if the method of feeding is such that they can get all the grain they want, are well supplied with succulent feed, and only what dry mash they want under such conditions.



GOSLINGS ABOUT TWO WEEKS OLD IN SMALL COOP AND YARD
Most of the geese start life this way —in small flocks.

When birds are so fed, the amount of animal matter in the mash may be increased to 20, 25 or 30 per

THOUSANDS OF GEESE ON A FATTENING FARM—THE PICTURE SHOWS ONLY ONE CORNER OF THE FARM

cent without bad effects, whereas a very slight increase in the amount in a moist mash would almost immediately cause bowel trouble. If poultry are kept short of hard grain and vegetable feed, and at the same time fed a highly concentrated dry mash with a large percentage of animal matter, they will eat the mash freely, and for a time it is likely to give remarkably good results. Before long, however, this highly concentrated ration produces acute digestive disorders, and leads to heavy losses. This danger in dry feeding, if not properly guarded against, takes from it the advantage of safety which is one of the principal inducements for using it. As the method of guarding against it is simply to feed the birds so well otherwise that they will not be tempted to eat rich dry mash in such amounts that they get too much concentrated animal feed, the regulation of this point is a simple matter.

HOPPER FOR GRAIN, SMALL BOX FOR MEAT SCRAP AND PAIL FOR WATER

The usual feeding appliances in the colony houses in the soft roaster district of New England.

It is claimed by advocates of dry mash feeding who are opposed to the use of moist mashes, that the feeding of dry mash saves labor. This is a point that has to be considered according to the circumstances in the case, and with due regard for the fact that when dry mashes are used special provisions are often, if not generally, necessary to supply succulent feed. It was this necessity that brought the use of sprouted oats for green feed into common use. While there are no doubt many instances where a net saving of labor is made by using dry mashes, it is doubtful whether that is generally the case. The real advantage as regards labor gained by the feeding of a dry mash always accessible to the birds is that it gives greater elasticity to the poultryman's daily routine, relieving him of the necessity of following a time schedule closely, and even permitting wide departures from it, in emergencies, without any serious effects.

And the great advantage of the dry mash method over the other, as both were practiced when dry mash feeding first came in vogue, is that with a palatable dry mash always before the birds none of them ever need go hungry. In ordinary practice the effort to feed poultry exactly in accordance with their requirements either as to the kinds of feed given or as to the quality, does not work well. To feed just what each lot of birds will eat up clean before the next meal, requires long experience, close observation, good judgment, and practically constant attendance. It makes feeding the part of the routine of poultry keeping to which every other part of the work must conform, and gives the poultry keeper opportunity for only such other work as can be done in the intervals between feedings. On a plant so large that the greater part of one man's time can be taken up in feeding, watering, and other daily routine, while someone else looks after the many other things to be done, this may not be a disadvantage; but on most poultry plants, whether taking all one man's time or less, one person has to look after everything, and when the feeding is on a rigid three meals a day schedule it will often happen that a meal is neglected, or given hastily and not in sufficient amount. This cannot be avoided, for there are all sorts of demands upon the poultry keeper's time; and many of them, of a nature that will not wait, come right at feeding time so often that the schedule cannot be closely followed.

In comparing results from the different systems, we must discriminate between instances where people who got poor results when using moist mashes get much better results by the use of a dry mash, and instances where the poultry keeper made a living profit by either system. When this is done, the dry mash system appears safest for the novice, and the one by which he is surest of getting fairly good results at the start. On the other hand, the moist mash system appears as that by which an expert in feeding gets the biggest actual results. Whether it will pay him to use the system that gives those results depends upon the purpose for which he keeps poultry, and upon whether he can feed on this system and still handle other parts of his work promptly as required.

Combining Wet and Dry Mash Systems

When dry mash feeding was first introduced and its merits became widely known, there was a general tendency to discard moist mashes entirely. Only a relatively small number of the poultry keepers who were getting good results from moist mash feeding held to that practice continuously and exclusively. The first results of heavy feeding of dry mashes containing much meat matter and other high concentrates were often so remarkably good that poultry keepers who had successfully used the other system for years were tempted to discard it. Both experienced and inexperienced poultry keepers too, being advised of the fact that in dry mash feeding much larger amounts of animal matter could be used with immediate good results, adopted the practice of adding more of such materials to commercial mixtures which already had about all of those ingredients that the manufacturers considered safe to put in them.

GRAIN AND MASH HOPPER FOR INDOOR AND OUTDOOR USE

The effect of such feeding was remarkable growth or egg production as long as the digestive organs could stand this extraordinary rich diet, and then sudden collapse. Poultrymen would have large stocks of chicks coming on remarkably well for three or four months, then they suddenly would begin to drop off in large numbers, and within a short time all would be gone except the few that could stand this diet, and even those would no longer show their former thrift. Where the use of meat concentrates was more moderate, but still too heavy for continuous feeding, the effects were not so striking or so sudden, but showed in an unusual proportion of losses from digestive troubles. Such experiences led some poultrymen to go back to their old system of moist mash feeding, but the greater number gradually saw the advantage of combining the two systems, making for each case such an intermediate system as would best meet its requirements.

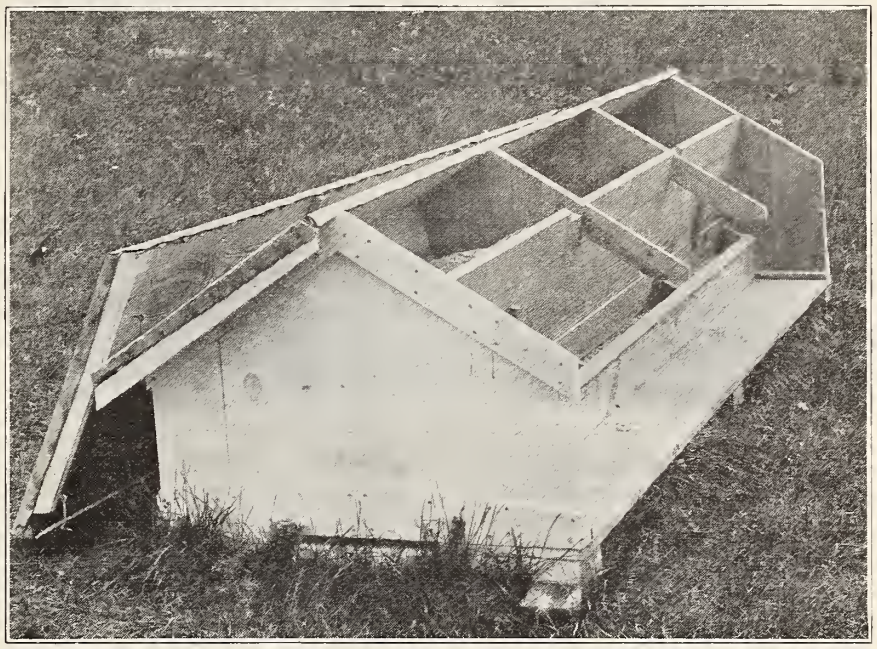
The most important general modification of the dry mash system was to discontinue efforts to compel poultry to eat the amount of dry mash necessary to give them the quantity of protein required to meet the estimated demands of remarkable growth or high egg production. This was brought about by simply increasing the whole grain so that the birds could eat about the same proportions of grain and mash that they usually will when fed a moist mash; and giving more abundant supplies of green feed—sprouted oats being extensively used for this purpose. The dry mash system so modified gives good results generally, and seems to suit the greater number of poultry keepers. It does not give the best results obtainable unless the feeding of sprouted oats is very liberal (or other succulent feed is freely supplied) and the oats fed while the sprouts are so short that the feed is really a combination of moist grain and green feed.

Where other materials that would similarly modify the ration are more available than sprouted oats, the modifications that are made usually take the form of moist mashes supplementing the dry mash. In this combination the moist mash is not, as in old practice, the basis, and in a sense the key to the ration, but is the convenient means of giving the things necessary to supplement the dry feeds, both ground and whole. The dry mash system thus modified is the one that gives the best results to most people, especially those of limited experience, and those who are not able to keep close watch of their poultry, and to study carefully all that relates to feeding.

In the work of highly expert feeders the best results are usually obtained by combinations in which the positions of the two kinds of mashes are reversed, the moist mash remaining a principal feature in the ration, and dry mash being used to supplement it to such an extent as will relieve the feeder of the close attention demanded by a rigid moist mash schedule, and will give the birds the opportunity to help themselves to dry mash when the feeder fails to supply the other on time, or when their inclination prompts them to take it.

Relation of Exercise to Feeding Methods

Poultry at liberty, foraging for their feed, take exercise walking or running about, and scratching or grubbing for feed—according to their nature and structure. Fowls are energetic scratchers wherever there is any promise of reward for such effort. Turkeys scratch some, but not nearly so much as fowls. Little chickens begin to scratch briskly as soon as they begin to try to pick up feed. The beak and the legs seem to have a tendency to work in harmony. Waterfowl do not scratch, but find what feed they get from below the surface of the ground by rooting and grubbing with their strong bills. It is this exercise that makes the muscles of their necks so strong while their legs are weak as compared with those of the scratchers. The necks of ducks and geese are so strong that these birds are caught and carried by the neck, instead of by the feet as is customary in handling fowls. The legs of ducks in particular are so weak that catching them by the legs is likely to cause dislocation.



OUTDOOR FEED HOPPER WITH THREE COMPARTMENTS
Photo from U. S. Department of Agriculture.

It does not seem to make much difference in the health of a bird what kind of exercise it takes, provided it gets a reasonable amount; nor is it necessary that the exercise should be strenuous. On the contrary, it is to the interest of the poultry keeper that poultry should take no more exercise than is actually needed to keep them in good condition and thrifty; for every motion a bird makes is using energy that comes from feed, and so whatever energy is used beyond the needs of the bird for exercise to keep it in physical condition, represents a waste. The adjustment of exercise of course cannot be accurate, but in a general way the proper relation is secured by giving a part of the feed in such form and under such conditions that it is eaten with little effort, and the remainder under conditions which make a moderate amount of effort necessary to obtain it.

With birds on range the matter of exercise does not call for consideration in the way that is necessary for poultry in confinement. Birds at large are likely to take much more exercise than they really need, and if they are left to provide mostly for themselves they may work

so hard for what they get that, while healthy and strong, they are neither productive nor as soft-meated as good table poultry should be. If the keeper wishes better production and better poultry under these conditions he can obtain his objects by any method that sufficiently reduces the amount of exercise the birds are taking while at the same time giving them equal or greater supplies of feed. Either reducing the numbers in flocks, making more flocks and placing them farther apart, or giving a little more feed, or both these measures together, will bring the results sought.

SCRATCHING FOR GRAIN IN LITTER—THE BEST INDOOR EXERCISE FOR HENS

With poultry in confinement—especially with fowls—regular provision for exercise is necessary if it is desired to keep the birds in good condition for a long term. With birds that are to be confined for only a few months and then killed, provision for exercise is not necessary and the results for such a period may be better without it. Thus in fattening poultry we prevent exercise that all feed consumed may go to fat. Even egg production, if the birds are in good condition at the beginning of confinement, may be better without exercise, until lack of it begins to cause weakness and low vitality.

The differences in temperament in different breeds of poultry, and to a less extent in different individuals of the same breed, also affect their requirements for supplied exercise. Small active fowls that are restless in confinement may take all the exercise necessary to keep them in good condition — to prevent indigestion — moving about the yard and looking for a possible opportunity to get out. While in one way serviceable, this form of exercise is not altogether beneficial, for contentment is essential to the most profitable production. However, hens with this restless disposition will take exercise enough of their own accord to prevent indigestion or the excessive accumulation of fat. That is the reason that hens of the light, active, nervous breeds so generally give good egg yields in conditions where the heavier breeds give very poor ones.

The most practical way to provide exercise for fowls, making it to a degree compulsory, is by feeding the grain in litter on the floor of the poultry house, using such depth of litter as is necessary to conceal a considerable part of the grain as thrown into it. This condition is secured by using only a moderate amount of litter at the start, adding to it as it becomes broken, and occasionally removing that near the floor which is finely broken and more or less mixed with droppings or earth.

Dry leaves make the best litter for this purpose, but comparatively few poultry keepers can obtain them in sufficient quantities to use constantly. Oat straw and planer shavings are the articles most commonly used for scratching litter by those who have to buy it. Dry corn stalks cut in lengths of about six to eight inches make good scratching litter, rather coarse, but durable and wearing for a long time without replacing. Any kind of straw, hay, weeds, or stalky rubbish that is not too coarse and tough will answer.

MRS. CHAS. V. KEELER FEEDING CHICKENS ON THE FARM RANGE AT "KEELERSVILLE", NEAR WINAMAC, INDIANA

The birds are Standard White Wyandottes not quite five months old, and weighing from four to six pounds each.

CHAPTER IV

Preparation of Feeds For Poultry

Suitable Equipment an Important Factor in the Several Processes of Cutting, Grinding, Cooking and Mixing Feeds For Poultry on Any Scale—Directions for Making Raw, Half-cooked and Cooked Mashes—Baking Johnnycake—Mixing Dry Mashes—Sprouting Oats—Preparing all Kinds of Kitchen and Garden Waste in Appetizing Forms

A MOIST mash, properly compounded and used, is a highly serviceable feature in a ration for poultry. A mash of the same ingredients, improperly made, becomes one of the most objectionable things in poultry feeding. The making of a good mash is not at all a difficult matter, yet in the days when the use of moist mashes was more common than now, probably not one in three of those who used them made mashes that were appetizing to the birds, and would give the results desired. The general reason for this was CARELESSNESS. Most people who used mashes learned to make them either by experimenting with mashes of different composition and mixed in different ways, or from instructions given in books and papers.

These instructions were not always as explicit as they should be. The most common description of the proper texture of a moist mash was crumbly, which is a very indefinite term. While a properly made mash is somewhat crumbly, a crumbly mash is not necessarily well made. It is difficult to put descriptions of the properties of such mixtures into words that will always convey just the meaning desired. In fact it is impossible to do so. The description that may give the right idea to the majority of those who read it will often fail to do so for a considerable number. The verbal description must therefore be regarded as never fully adequate, but more or less accurately suggestive to different persons according to their habitual understanding of the words used, and always to be tested as to the correct interpretation of it by the appetite the birds show for the mixture made, and by the absence of undesirable effects in using it.

Suitable Equipment the First Essential

Where moist mashes are to be fed regularly to any considerable stock of poultry, or are to be used at all for a large stock, convenient apparatus for cooking and mixing, and for handling the mash in feeding should be provided. Much of the complaint about the labor involved in the use of moist and cooked mashes arises from the fact that proper facilities for such work are not provided, and so either a great deal more time is used than is really necessary, or the work is not done as it should be.

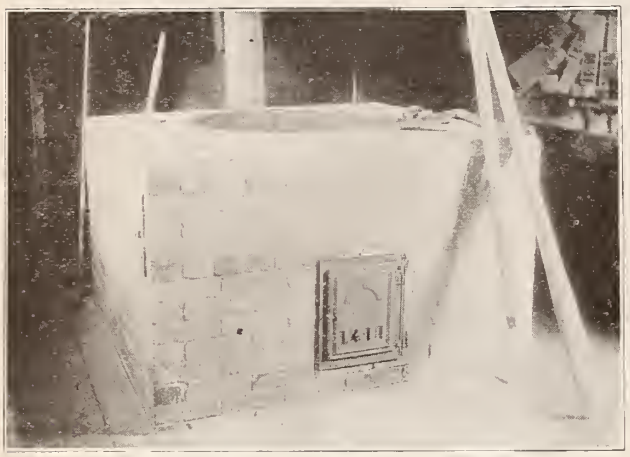
Equipment For Mixing a Pail of Mash

In a 12-quart pail, up to eight or nine quarts of moist mash can be conveniently mixed. Where mash is given as a full meal, a quart will usually feed from six to eight or nine medium-sized hens. A light bulky mash—if appetizing—is eaten in much larger quantities than a more concentrated mash that is just as much relished by the fowls. So, according to the kind of mash made, an ordinary pail will answer for mixing the mash for flocks up to about 75 birds. In a 16-quart pail about twelve quarts may be mixed. That is about as far as we can go without making special provision for mash making. When mash is mixed in a pail and scalded, an ordinary teakettleful of water is required to make a pailful. The mixing may be done either with a heavy iron cooking spoon or

ADULT STOCK WILL THRIVE IN BARE YARDS WHERE OTHER CONDITIONS ARE RIGHT
This flock has a roomy house with scratching quarters underneath, and the relatively small yard drains well away from the building. In the distance the young stock may be seen on good grass range.

with a hardwood paddle of convenient size for stirring with one hand. Where both moist and dry mash are fed, (limiting the allowance of moist mash and making it only a partial feed), mixing in a pail may answer for as many as one hundred and fifty birds.

For convenience and for more satisfactory results in every way, it often will be found desirable partially to mix in the pail a larger quantity than can be handled in it when all the ingredients are added, completing the mixing in a box or trough, using a common garden spade



OLD FASHIONED BRICKED-IN SET-KETTLE

for the purpose. For such quantities more water will be required than can be heated at one time in an ordinary teakettle, so the trouble of making scalded mashes without special equipment increases at every point as soon as we go beyond what can be done with the teakettle on the kitchen stove and with common appliances. It is better then, as a rule, either to mix mashes cold, or to get special cooking apparatus of the required capacity.

Small Cooking Apparatus

For cooking feed on the ordinary small poultry plant needing special equipment for the purpose, either feed cookers or iron set-kettles may be used. The former are manufactured and sold for cooking feed for all kinds of live stock, and consist simply of a stove with a boiler. The stove cooker is cheaper, and unless the poultry keeper can do his own bricklaying is less expensive at the outset; but the bricked-in set-kettle is the more durable, and also being of substantial construction, can be used for the whole process of mixing where the lighter cookers on stoves can only be used for cooking or for light mixing, as neither the vessel nor the stove will stand the heavy pressure of mixing a large batch of stiff mash with tools requiring two strong hands.

Where the mixing must be finished in a mixing box on the floor or on short legs, the full water capacity of the cooker may be used, and no larger cooker need be installed than is required to heat the water needed. But where all the mixing is to be done in the kettle it should have a capacity about fifty per cent greater than the amount of mash it is desired to mix in it at one time. Thus if we estimate twelve quarts, or three gallons, of mash to every hundred birds to be fed, one thousand hens will need thirty gallons of mash. A 40-gallon kettle would serve for cooking and mixing this but would be rather small to work in freely and rapidly, and the additional cost of a 50-gallon kettle would soon be used in extra time. The size somewhat larger than is actually required not only gives more freedom and rapidity of action in ordinary usage, but admits of mixing much larger quantities of feed on special occasions. It is always well in installing a set-kettle to put in as large a size as will ever be required.

For mixing feed in a set-kettle a round-pointed, long-handled shovel generally is found most serviceable, though big wooden paddles and forks like those shown in the illustration on this page also are much used. In mixing in a kettle with a long-handled implement, the edge of the kettle is like a broad fulcrum on which the shovel works, shifting up and down as it is moved through the mass. This wears the handle rapidly and to provide for this either a shovel with long straps on the handle should be bought, or the underside of the handle should have a strip of iron put on to protect the wood and prevent it from rapidly wearing so thin that it will break.

When a mixing box or trough is to be used it should be large enough to admit of the fullest freedom of movement in working over the mass of ingredients. The smallest box that it is worth while to build and use is four feet long, eighteen inches wide at the top, whether made with straight or with flaring sides, and from fifteen to eighteen inches deep, according to the construction of the sides. For quick work with small batches of mash (three to ten gallons), a trough eighteen to twenty-four inches wide at the top, should have a depth of eighteen inches, and a bottom width of ten inches, smaller troughs being made in these proportions. Such a trough will be found more satisfactory than straight-sided boxes, for in the deep trough, narrow at the bottom, the depth of the mass being worked over is greater than with the same quantity in a wider, shallower box, and with the steep, sloping sides what is uppermost falls in and down every time the implement used in mixing is lifted up through it. Large troughs of this construction are not satisfactory because their greater depth and wider flare keep the man doing the mixing too far from the center of operation and the strain on him is too great.

For large batches of mash to be mixed by hand power, boxes are used that are built wide enough for two

INTERIOR OF COOK ROOM
Showing stove, cooker, and mixing trough.

men to work, one on each side, and long enough to give room to work the mass back and forth from end to end to insure thorough mixing. Such a box will be about five feet wide, from eight to ten feet long, and a foot deep. A box less than eight feet in length will not give two mixers freedom of movement, while one more than ten feet long takes a larger batch than can be mixed well and

quickly by two men, and makes an excessive reach in working the mass back and forth. Where boxes of the dimensions given are not large enough, and it is desired or necessary to feed moist mashes, power mixers should be installed. Unless, or until, this is done it will be found more satisfactory to mix at one time only what can be handled in a box of convenient size, and to shovel each batch (until the last), as mixed, into a pile in a convenient place near the box or into the containers in which it is to be distributed for feeding. Some poultrymen who mix in this way have a large, deep box or bin at the end of the mixing box so placed that the mash can be conveniently loaded from it into wheelbarrows or carts.

For mixing mash in such boxes as have just been described, square-edged dirt shovels are used, either with long or with short handles as may be preferred. The length of shovel handle preferred will depend both on the height of the man doing the work, and on whether the box is placed directly on the floor or raised a little from it.

Steam Cooking Apparatus

Years ago a good many of the largest poultry plants that cooked mash to feed their adult stock once a day, and to growing chicks in the season, and so used large amounts of soft feed, had steam cookers of various capacities and types. The mash as cooked in these was mixed cold, about like a rather dry johnnycake batter, and in cooking it was really baked so that it came out much like a big underdone cake. The cooking was generally done slowly. Often the mass was put in a big steam jacket kettle late in the afternoon and cooked with slow heat all night. Of course not all who used these cookers were good cooks, and many fed the cooked mash in rather poor condition. When well made and cooked it was splendid feed, but the results of using it were not noticeably better than were obtained by the use of scalded and cold-mixed mashes, and cooking on this scale was long since generally abandoned.

Mechanical Feed Mixers

There are mechanical feed mixers suitable for mixing either moist or dry mashes made both in small sizes for hand power, and in larger sizes for high power. Poultrymen also frequently make homemade contrivances of this kind. The use of these rather than of the more common equipment described is generally determined by and is in keeping with the general character of the equipment of the plant. There is not the same advantage in the small mechanical contrivances of this class as in the large ones operated by power, but many people prefer custom-made to homemade equipment as more businesslike and giving a better appearance and distinctive character to their plant.

Power Feed Mixers

The type of machine most commonly used where large quantities of mash must be mixed for poultry, and especially on duck farms, is the baker's dough mixer,—usually bought secondhand and at much less than the price of a new machine. With such machines large quantities of feed can be mixed rapidly and thoroughly. A half-ton lot, or even more can be mixed in about the time it takes thoroughly to stir up a pail of mash.

Shelling and Grinding Machinery

To a large poultry plant that grows any considerable amount of corn, or the poultry plant on a farm using power machinery of this class in connection with the care of other kinds of stock, a corn sheller and a mill that can be adjusted either to crack or to grind corn are very useful. The question of the economy of purchasing such machinery depends not only upon the supplies to be put through them, and the cost of power, but upon the cost of the machine. As a rule it is not good policy to go very far in the purchase of this kind of equipment until a business is well established, for few large plants can mill much of the feed they use, and the occasional use of expensive machinery does not meet the cost of it except in a long term of years.

Hay, Fodder and Root Cutters

Where hay and forage plants are grown on the farm and fed either dry or green, a machine that will cut them fine is serviceable. Such machines can be obtained of almost any size desired, and the smallest are so inexpensive that a poultry keeper with more than a few dozen birds can hardly afford to be without one. Some of the small hay cutters will cut hay almost as fine as meal and do it quite rapidly. Machines for cutting fodder are especially useful when it is to be mixed in the mash. Root cutters will usually pay for themselves even if a large part of the roots used are fed without cutting, for they are not expensive and it is often found convenient to use them.

Bone Cutters

Wherever there is an opportunity to get green bone and meat, in quantities that make the trouble of getting it worth while, it pays to have a bone cutter, especially if it can be run by power. Even with occasional and irregular use a machine of appropriate size will pay, for with it a valuable feed can be prepared which otherwise is obtainable only by poultry keepers who can buy of retail meat markets that cater to the demand for cut bone. There are a few of these in most large cities, but not many elsewhere. The use of a bone cutter is not limited to cutting bone. Though much stronger than is necessary for the purpose it can be used for cutting up stale bread, crackers, etc., and even as a vegetable cutter, when these things are not required in large quantities. Many small poultry keepers use a bone cutter for such a variety of purposes.

Mixing a Scalded Mash in a Pail

In making a scalded mash containing corn meal, the point of first importance is to have the water boiling. When boiling water is poured on meal of good quality it begins to swell immediately and will absorb a considerable quantity of water without becoming sloppy. In starting to mix such a mash the amount of meal that is thought to be sufficient should be put in the pail, and the boiling water then poured over it, stirring the mass at the same time, and continuing stirring and adding water until all the meal is well mixed and of the consistency that will sufficiently moisten the other ingredients when they are added to it.

This point of consistency can only be judged by experience. Skill and judgment in using just the right amount of water are acquired through practice. The desirable consistency of this mush, of course, depends on the proportion of other things that are to be added to it. If the meal constitutes one-fourth or one-third of the dry ingredients of the mash, it must be thinner when the other things are added than if it constitutes one-half. Also if the meal is of poor quality and will not swell instantly when wet with boiling water it will not absorb nearly so much water, in fact will not seem to absorb much at all, but will settle in the water much like sand does. What to do in that case will be described later.

In the most simple mashes either bran, or bran and middlings, and meat scrap are added to the meal. The bran and middlings as purchased may be separate or may

be mixed. The best consistency in a mash is usually obtained when the bran and middlings are in about equal proportions, but if the mixture is to be half corn meal it does not make so much difference if the coarse light bran is somewhat in excess of the fine middlings with their greater adhesive properties.

Whether the ingredients added to the meal are put in separately or added one by one is immaterial. The point in regard to them is to have them thoroughly mixed with the scalded meal, and to have the resulting mash as dry as it can be with all that has been added to it moistened. A mush that seems as stiff as it can be stirred will take from two to three times the bulk of the dry corn meal in it to make this consistency. To work it in thoroughly takes strong stirring, but does not take long if one has the strength of hand for it, and acquires the knack of working the mass systematically to secure thorough mixing quickly. It can be done in a small fraction of the time required to explain it.

While the proper—or rather the most desirable—consistency of the mash is attained by having it just moist enough all through to hold together as fed out, it should not be supposed that there is peculiar virtue from a nutritive standpoint in this degree of moisture. A little more or less moisture will do no harm, though it will be found that the birds usually like the mash best when it is about as described above. If it is rather wet they may not eat it quite so well. If there is much dry stuff in it they may eat it regularly enough but are likely to scatter and waste a great deal more of it.

In adding mill stuffs to get the desired degree of dryness, a novice will often get in too much bran, with the result that the adhesiveness of the mixture is very slight. This condition can be remedied by adding a little more water, either hot or cold, and then stirring in a little fine middlings, red dog, or low-grade flour. It is a good plan to have some of one of these articles on hand to use in such cases, and also to make the mash a little richer and of different flavor by way of change from time to time.

If a mash appears much too wet when the other mill stuffs have been added to the scalded meal in the intended proportions, it may be because the mush was made too thin or because of an unusually large proportion of middlings in a mixture of bran and middlings. The best thing to do then is to add bran or mixed feed—whichever is being used, or if this seems likely to make too light and bulky a mash, to put in more corn meal, using it raw. It will take up moisture more readily than anything else, though not to the same extent at once as when wet with boiling water.

Mixing a Cold Moist Mash in Pail

A mash of the same ingredients as described above may be mixed cold, and good consistency obtained, by suitably limiting the amount of bran in it and using more of the "sticky" wheat products, especially red dog, or low-grade flour. This will mean, in the first place, the use of more meal. Enough more must be used to make the bulk of meal when wet with cold water (which will not swell it at once as much as boiling water) nearly as great as that of the meal required for a scalded mash for the same number of hens. It should not be quite as great, because this is a heavier mash than a scalded mash and the birds will not eat so much of it, nor is it desirable that they should do so.

The knack in making the cold mash is to get the proportion of fine middlings, red dog, or low-grade flour that will hold it together and make it palatable when the cohesive property in the corn meal is only partly brought out. It is harder to mix than a scalded mash, requiring more strength and skill in mixing; and unless one has strong hands and arms he will find it much more satisfactory to use a mixing box and a spade for batches of cold-mixed mash in excess of five or six quarts. In fact, for either cold or scalded mash in quantities of more than seven or eight quarts it will be found that the quickest and easiest way is to use a mixing box.

Mixing Large Batches of Mash in Set-Kettles

In making mashes in this way the meals used are cooked more than in a scalded mash, though not usually by any means thoroughly cooked. The amount of water required is placed in the kettle and the fire under it so managed as to have it nearly burned out when the water comes to a boil.

If this is not done and there is a hot fire that will burn some time longer under the kettle when the feed is mixed, it will burn to the kettle, making mixing more difficult and also making additional work cleaning the kettle afterwards. On most plants large enough to need cooking appartus of this kind, there is enough old rubbish and light wood of various kinds to use in cooking feed, and after a little experience one learns just about how long it is necessary to keep the fire going to have it meet the requirements and also give economy and efficiency in the use of fuel.

If clover, alfalfa, or cooked vegetables are to be used in the mash, they should go in before the corn meal. Alfalfa that has been cured quite soft and green has a tendency when fed to make the droppings of poultry pasty and of a dull yellow color. This is prevented by slightly scalding it. If when the water is boiling what finely cut alfalfa or alfalfa meal is to be used in the mash is put into it and well stirred before the corn meal is put in, no looseness of droppings will appear. If vegetables are to be fed in the mash they must be either boiled so that they can be mashed first, or run through a root cutter that will cut them fine enough to mix in it.

The process of mixing from this point, when vegetables are used, or from the start without them, is just the same as when mixing mash in a pail, only on a larger scale and with larger apparatus, requiring two hands and being a full-size, man's job, for to be done well and as easily as so large a batch can be handled it must be done quickly. Otherwise the heat which is still under the kettle and in the brickwork around it will dry the mash so fast that it becomes stiff and hard to handle, and this difficulty is increased by the greater stickiness of the meal due to partial cooking.

When the mash is mixed in the morning it is usually fed right after mixing. Many poultrymen prefer to mix it at night and let it stand in the kettle until feeding time next morning. Handled in this way the mash is pretty well cooked when fed. An objection to leaving the mash in the kettle, especially if the fire continues to burn for some time after it is mixed, is that it often burns to the kettle. The easiest way to keep the kettle always clean and smooth is not to allow mash to remain in it after mixing, but to take it out at once, put a pail or two of water in, and, with a broom kept for the purpose, wash the sides of the kettle clean, letting the feed washed from them remain in the water to which more will be added the next time feed is cooked. When feed is cooked daily there will be no danger that feed thus left will sour, but whenever there are to be longer intervals between cooking it is better to empty the kettle.

Making Large Batches of Mash in Mixing Boxes

Making a Scalded Mash—The process in this case is the same as in the use of small mixing boxes, but on a larger scale, and with attention to a few points that do not have to be especially considered in handling small batches. The meal being scalded in the vessel on the cooker and vegetables (if any are to be used) having been handled as in the preceding case, the other ingredients of the mash are spread evenly over the bottom of one end of the mixing box, as a mason spreads the sand in a mortar bed before running his slaked lime on it. Drawing the material a little high at the sides of the box will prevent the mush from sticking to them, and ridging it across the bottom of the box will prevent the mush from spreading past it. All this can be done with a few motions of the mixing shovel.

The scalded mush being turned in on this, the mass is mixed with shovels. The work is done rapidly and thoroughly if after the mash is about half mixed it is

FEED WAGON AND POWER MASH MIXER AT KEITH DUCK RANCH, EASTON, MASS.

The mash mixer in the upper part of the picture is self-dumping and empties into the feed wagon below.

simply shoveled to the opposite end of the box, turning each shovelful over as put down. Shoveling it over this way two or three times should be enough. After one gets the knack of it, this can be done quickly, especially by two men working together, one on each side of the box. In all mixing of large batches of mash, whether moist or dry, two men can do the work in about one-third of the time required for one man to do it. As two men usually do the feeding where it is on such a scale, there is no occasion to let the services of the extra man in mixing mean loss of time in drawing him from another job especially for this.

Making a Cold Mash—As in making small batches by this process, the corn meal is wet and then handled just the same as when scalded, and the same attention must be given to the use of smaller proportions of bran and more of the finer materials. Where convenient the meal may be wet for twelve hours or so before mixing. This can be done either in pails or in the mixing box. A method used by some poultry keepers with very satisfactory results when a liberal amount of meat scrap is used in the mash, is to spread the scrap on the bottom of the mixing box and pour on it as much water as it will absorb when soaked for about twelve hours and be quite wet. The amount of water this material will take in this way is much greater than one who has never tried the plan would suppose, and is usually sufficient to saturate the mill stuffs of the mash when they are added and the whole thoroughly mixed.

Mixing Moist Mash By Machine

Machine-made mashes are—so far as the writer's knowledge goes—always cold mixed. Where machines are used it is mostly necessary to make a number of mixings, and to undertake to scald or partly cook the meal for them would make a great deal more work and trouble than would be warranted by any possible improvement in the feed as a result. As the reader may infer from the emphasis placed on the importance of manipulation of ingredients to utilize as fully as necessary in each case the cohesive properties of the finer and heavier ingredients to bind the coarse and light material, the principal advantage in scalding mashes is to bring out the cohesive property in meal, especially in corn meal. In mixing mash by hand it is easier to get the consistency desired with corn meal that swells nicely than with anything else. To get similar consistency with the corn meal only wet and wheat products furnishing the binder, takes much more power in mixing. This is a decided drawback to cold mixing by hand, but a machine driven by engine or motor has all the power that is needed for the work—and to spare,—hence where the machine is used, cooking or partial cooking is superfluous.

From what has been said of the power of mixing machines, such as are used on large poultry plants, it may be inferred that it makes no particular difference in what order the ingredients go into the mixer, which usually is large enough to mix a batch requiring a hundred-pound bag of each ingredient. The custom of starting with the meal probably is most widely followed, much as a matter of habit. In mixing on this scale the mixer, which is a large heavy machine requiring a firm foundation, is usually on a cement floor on the ground floor, or basement, and the feed is stored in a room over it, with an opening in the floor just over the mixer so that the ingredients can easily be poured directly into it.

Three men are usually required to operate such a mixer to advantage,—one in the feed room, one at the mixer to put in the water and to dump the batch when mixed, and a third to take away the mash as turned out on the floor, either shoveling it into pails or boxes in which it is to be distributed, or into piles out of the way. The water is sometimes put in with a hose, sometimes by the pailful from barrels of water at hand. This last admits of exact measurement of the water to be used, but some men become so expert in judging without measuring that they use the hose letting the water run as the grains are poured in and shutting it off when the appearance of the mash indicates that enough has been used to give the desired consistency.

When cut green feed is mixed with mash in making it on this scale, a fourth man may be used to cut it and bring to the mixer as required. The time consumed in mixing a batch of mash in this way is usually about five minutes. These big mixers are used principally on duck plants. When the subject of feeding ducks is considered in detail the reader will see that even with this quick work quite a little time must be given every day to the mixing of feed on a large duck farm.

General Notes on Making Moist Mashes

To make the description of methods under different conditions as connected as possible, we have in the foregoing pages kept closely to the plainest mashes that

can be made, and to mashes mixed with water. Under this heading will be considered topically the points relating to the use of other materials.

Milk in any liquid form obtainable, or whey, may be used instead of water in making mashes. Sweet skim milk will bind the mill stuffs better than water, but with sour milk and whey no difference will be observed. When milk is heated it is generally desirable to avoid scalding it to an extent that will make it constipating. The exception is that when the mash mixed with it is to be fed to birds that are a little inclined to looseness, the scalded milk in the mash may be a corrective for this. Dry milk products can be handled in mash making in the same way as meat scrap.

Clabber milk and the commercial semisolid buttermilk are always best used cold, and are especially good for both milk and bran mashes, which are most excellent for feeding in hot summer weather, also for heavier mashes of milk and corn meal—sometimes with meat scrap added—that are good both for fattening and as occasional rich feeds for variety.

Oat Products in Mashes—Whenever good ground oats, rolled oats at feed prices, or any substantial oat product can be obtained, it is a good idea to substitute the oat product for about half the corn meal commonly used in making mashes as described in preceding paragraphs. The combination of oats and corn, especially when they are coarsely ground together, is one of the most appetizing and useful mashes,—a little rich for general regular use, but most excellent wherever a rather concentrated, highly nutritious mash is wanted. Ground oats alone do not swell as much and as quickly as the best corn meal, but swell more than inferior corn meal. With good meal the mixture swells well, with poor meal the oats in combination give a better result. These statements refer to ground oats in which the hull is not present in excessive amount.

Soft Fruits and Vegetables in Mashes—Tomatoes and pears, peaches, plums, and occasionally soft varieties of apples are often available for small flocks of poultry in quantities far greater than can be used to advantage if fed separately to birds that get some soft mash besides. A good plan in such cases is to mix the mash with the fruit or vegetable, and also allow the birds all they will eat of it separately. The mash is made by crushing the fruit or vegetable to a pulp and then mixing the mill stuffs with it, using them in any proportions desired. For mashing such articles in larger quantities than can be mashed and mixed in an ordinary pail, a tub made by cutting a keg of convenient size in two may be used, or if none such is available a common pail will do, though ordinary light pails of either metal or wood will not stand much of this treatment without breaking the bottom. A wooden pail may have the bottom reinforced by attaching a round piece of suitable thickness to the underside with screws. A metal pail that is strong and has a perfectly flat bottom may be used without damaging it, but a pail with the bottom creased, or with the sides extending below it ought not to be used in this way.

The mashing may be done with any heavy wooden implement of suitable form and size. For occasional use or for small quantities, a pick handle makes a good masher. If, however, there is frequent occasion to use one, it is worth while to make one with a broader mashing surface. A section of a round stick of cordwood, from eight to twelve inches long, and four to five inches in diameter, with a hole bored in the center of one end, and a broom handle, or round piece of wood of about that size driven into it for a handle makes a good masher for this purpose.

Table Scraps in Mashes—For feeding to poultry it is nearly always better to mix a little bran and meal with table scraps, as saved for the purpose, than to give the scraps alone. The dry mill stuffs take up the moisture in the scraps, of which there is sometimes a considerable amount, and as these are leavings of gravies, soups, cereals with milk, puddings, etc., the nutritive matter in them is all saved when they are mixed in a mash, while if simply put in a trough these soft and more or less fluid things are not always eaten clean, and the frequent feeding of them in this form results in very dirty troughs. Where the flock of poultry is small and the scraps mixed in a mash make more than is required, it will often be found that by simply taking care to keep out of the vessel in which the scraps are collected, the fluids that have no special value (and might as well go down the sink drain), the moisture in the scraps is reduced so much that the appropriate amount of meals with them does not make more mash than is needed.

In the use of table scraps for poultry, and also when feeding meat trimmings, as when hogs are butchered on the farm, care should be taken not to give the birds opportunity to swallow large pieces of fat meat. A fowl can swallow quite a large strip of fat as it is often cut from a piece of meat at the table by a person who does not eat fat, or trimmed from the raw meat by the cook before cooking, and fowls are quite fond of a little fat, and quickly pounce on any they find in their feed.

It is probable that large pieces of fat often are swallowed in this way and do no injury; but it is also certain that in a great many instances fowls known to have swallowed large pieces of fat, or to have had the opportunity to eat freely of fat, have died shortly after with acute symptoms of poisoning. For that reason, either instructions should be given to those saving scraps for poultry not to put such pieces of fat with the rest, or the person doing the feeding should always be on the lookout for them, and cut them up before feeding. If this is done no one bird can get enough to injure it, and what each gets will be a benefit to it.

HOMEMADE OAT SPROUTER

Infertile Eggs in Mashes—When eggs are available to feed to young poultry the best way to use them is to break shell and all, and stir with them as much meal or mixed mill stuffs as the egg will moisten.

Making Sprouted Oats

Sprouted oats, while not the first choice of green feed for poultry, are probably used by more poultry keepers than anything else, because they can practically always be produced, in any quantity desired, in a few days. All that is necessary is to keep them moist and at a temperate degree of heat. They may be sprouted in small quantities in a box in the house or cellar in winter, or in any convenient spot on the ground outdoors in spring and summer. Where they are to be used regularly for any considerable period, it is advisable to make systematic arrangements for a continuous supply. This is easy outdoors in summer. All that is necessary is to have a regular succession of plots of oats spread about an inch thick on the ground and kept wet,—each plot being of such size as is required to furnish the oats needed for the number of days intervening between the times of starting plots. Where a great deal is used, the intervals may be daily. Usually it is not best to have them longer than three or four days, which admits of beginning to feed from a plot when the green sprouts are of fair length, and finishing it before they become too long, and the nutriment in the grain has all gone to stem and root.

It should be kept in mind in preparing and using sprouted oats, that the greatest value is not in their use as green feed only, but in their use as a combination of soft grain and green feed. In careful practical observations on the feeding value of sprouted oats at different stages, one of the largest farms in America found that the most economical way to use them is to feed when the sprouts are about an inch long. When it is more important that they should provide green feed than that they should give the greatest possible nutritive value from the grain, they should not be fed until the sprouts are several inches long; but the poultry feeder should plan to have larger quantities to feed while comparatively short, rather than to get the greatest bulk of green feed. Another advantage in this is that the shorter the time of growth for the oats used the less trouble there will be with the formation of molds, which often are injurious to poultry.

For sprouting oats indoors the most common practice is to use trays about 24 to 30 inches square and about 2 inches deep, arranging these on open racks or in closed cabinets in tiers 12 to 15 inches apart. The advantage of the closed cabinet depends upon the temperature of the place where the oats are sprouted. It can be heated with a lamp or otherwise, and more rapid growth secured where the room temperature is too low for quick growth. While some poultry keepers make their own equipment for sprouting oats, probably a far greater number buy sprouters as made and sold by manufacturers of poultry appliances. Poultry keepers who use a great deal of sprouted oats sometimes devote a good-sized building to the purpose, not placing the oats in many tiers as in the small racks and cabinets, but using a wide bench about 30 inches high, and also the space under this on the floor. This plan saves labor, but calls for more space and a special building or a large room devoted exclusively to this work. Usually these oat-sprouting rooms are arranged so that hot water or steam heat can be used to keep the place at the desired temperature.

The common process in sprouting oats is to soak them in water for twelve hours or more before spreading them in the trays. The depth of the layer may vary from an inch to about two inches. Where the depth is over an inch it is necessary to stir the oats daily until the sprouts are so long that this will break them off. In so thick a mass the tendency is for those at the surface to dry much faster than those in the middle. The oats are sprinkled daily, or oftener if it seems necessary. They must be kept moist, but not too wet.

The tendency to the formation of mold makes it advisable to wash trays with a disinfectant before each lot of oats is put into them. A solution of equal parts of formalin and water is commonly used for this purpose.

Making Baked Johnnycake for Chicks

Johnnycake, whether of corn meal alone, or made of a mixture of meals, is one of the best of chick feeds. The trouble of making it precludes its use generally where chicks are grown on a large scale. The advantage of using it is greatest where the number of chicks is so small that the amount of a moist mash they can eat while it remains in good condition is not large enough to make it worth while to bother with moist mash. A poultry keeper who has a few broods of chicks with hens can bake a cake that will last them for three or four days or more. For any larger number of chicks bakings can be made at as long or at shorter intervals, according to the size of the flock and the amount that can be baked at one time. Also the baking can be done when convenient, while the mash must usually be mixed at stated intervals.

Any woman who knows how to make a johnnycake, or corn bread, for the family table can make a good feed for little chicks by the same recipe. It may be better than is really necessary for the chicks, but since it will be good chick feed there is no excuse for one who can make it giving their little chicks feeds that are not giving satisfactory results. When in doubt or in trouble with little chicks, **feed johnnycake**; is good advice for the novice. It may not be economy or good policy to use it heavily and regularly, but it is the reliable stand-by in emergencies.

Johnnycake as made for chicks can be of coarser material, may have in it any infertile eggs that are not affected with rot, and may also have any table scraps that can be readily mixed with the batter. The following recipes are given for johnnycake for poultry feed:—

No. 1—Corn meal, 1 quart; infertile eggs, 1 or 2; baking soda, 1 teaspoon. If eggs are not available use double the quantity of soda. Mix with sour milk to a stiff batter, and bake well.

No. 2—Take 1 pint of corn meal, 1 teacup of wheat bran, 1 teaspoon of meat meal, 1 teaspoon of soda, 1 teacup of cold water. Mix thoroughly, and bake 2 hours.

No. 3—Take 3 quarts of corn meal, 1 quart of wheat middlings, 1 cup of meat meal. Mix with water or skimmed milk to which add 4 tablespoons of vinegar and 2 teaspoons of soda.

No. 4—Add a little soda to sour milk—about a teaspoonful to the pint of milk. Stir in coarse corn meal and ground oats in equal parts to make stiff batter, add one infertile egg, broken shell and all, for each pint of batter. Bake in deep pans well greased.

No. 5—Cornell johnnycake. 4 pounds of corn meal, 1½ lbs. (1 dozen) of infertile eggs, 5 pounds (2½ quarts) of sour milk, 5 level teaspoons of baking soda. Stir thoroughly and bake well.

It will be noted that the proportions of eggs in the different recipes vary greatly. This point is usually regulated by the available supply of eggs for the purpose. Within these limits the more eggs the richer and lighter the cake.

Mixing Dry Mashes and Scratching Mixtures

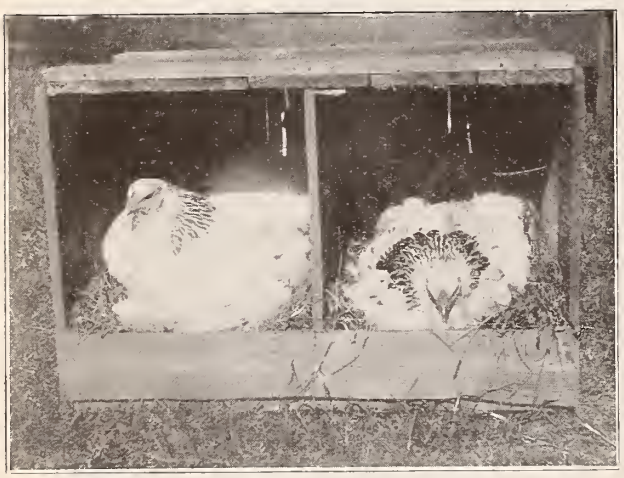
Small lots of dry mash or of fine grains may be mixed in mechanical mixers of convenient and appropriate size. Large batches usually are mixed with shovels on a smooth board or cement floor. Any spot swept clean will do. The mixing can be done with scoop shovels, for the dry stuffs are much easier to handle and mix than wet. The job should be thoroughly done in order that the mash as distributed to the poultry may be uniform in quality and composition. After mixing, the mash is either bagged or put in bins from which it is taken as required, or is, perhaps, distributed at once to the feeding hoppers.

CHAPTER V

Feeding Chicks From Hatching to Weaning

Relations of Vitality in Chicks and of Conditions of Life to Results in Feeding—Contaminated Soils Bad For Young Chickens—Differences in Details of Practice With Hen Brooded and Artificially Brooded Chicks—Model Rations For All Localities and Climates — Quantities of Feed Consumed by Baby Chicks

A BABY CHICK is a tender little thing, so susceptible to extremes of heat and cold, and so easily hurt by rough handling, that people naturally suppose that it requires especially easily digested feeds. Even after long experience with chicks, most people do not fully realize that the only necessary differences in the feeds of large fowls and small chicks are that the pieces of the feeds they cannot separate with their beaks must



READY TO LEAVE THE NEST

be smaller for chicks, and that the use of unwholesome things, even in small quantities, must be more carefully avoided. Nothing that an old hen can digest is too hard for a baby chick: in both, sound physical condition is essential to good digestion.

Measured by results, the digestive power of healthy, thrifty chicks is greatest in the first few months, and greater at any period of growth than in adult life. A hen that weighs about five pounds, and lays 200 eggs in a year—the eggs weighing 24 ounces to the dozen—produces about five times the equivalent of her own weight in eggs in the year. An average chick hatched from one of these eggs, and weighing less than an ounce and a half when hatched, will weigh—if well grown—one pound when eight weeks of age. It will have increased its weight at the beginning of the period **more than ten times.** In a second period of eight weeks it will add to its weight three pounds, increasing its weight at the beginning of the period three times, and making its total weight four pounds, which is **more than forty times its weight when hatched.**

When growth is at this rate the average daily increase in the first months is approximately one-sixteenth of the weight at the beginning of the day. Many thrifty chicks have a higher rate of growth and continue it much longer than the average. As a chicken that is growing well approaches a pound in weight the increase is often more than an ounce a day. The real capacity of a chick for growth is still more strikingly illustrated by comparison with large mammals or with human beings. A child that weighed eight pounds at birth and grew at the rate stated for chicks would weigh at sixteen weeks, 352 pounds. A calf that weighed fifty pounds at birth and grew at this rate would weigh 2200 pounds when sixteen weeks old. The rapid growth of young poultry is possible only when they are in good health and well fed, and because they are able to eat and digest relatively large quantities of rich and highly nutritious feed.

As soon as anything goes wrong with a young chicken in any other respect, digestion is immediately impaired too. The digestive organs, so powerful when working right and on suitable material, are peculiarly susceptible to all the effects of stale, musty, and moldy feeds, and also to the effects of eating feeds that have come in contact with soil contaminated by the droppings of poultry, even when the contamination is not recent and no traces of it may be visible to the eye. That is why mature poultry can be kept in good condition and producing well in much more closely restricted quarters than would suffice to grow the same number of chickens.

While ideal conditions are desirable for young chickens, it is not always possible to have these. In all highly intensive poultry culture there are various conditions that are not the most favorable for poultry, yet are not so detrimental that good results become impossible. Indeed, if poultry keeping were carried on only under ideal conditions, many successful backyard poultry keepers would not be engaged in it, or would have to curtail greatly their operations. Good care and good feeding go a long way to offset drawbacks of conditions. When conditions are more or less unsatisfactory, good work depends upon the poultry keeper thoroughly understanding the disadvantages that he must contend with, and taking every necessary and wise precaution to counteract them. Good work under poor conditions will often give

THE FIRST DAY OUT

An old fashioned coop as still used on some farms. The hen is tethered to the coop. The feeding board is used to close the coop at night.

much better results than indifferent care under better conditions.

In presenting the subject of feeding for many different conditions and for different purposes it is necessary sometimes strongly to emphasize points as they apply to one set of conditions which under an entirely different set of conditions require but little attention. The reader should therefore always note carefully to what circumstances certain emphatic instructions do apply, and to what they do not apply. Failing to do this, poultry keepers often do a great deal of unnecessary work. This may not make any particular difference when the flock is small, and when the work of caring for it is considered recreation, but where poultry keeping is on a commercial basis unnecessary work is always to be avoided.

COOPS FOR HEN AND CHICKS USED AT THE GOVERNMENT POULTRY FARM, BELTSVILLE, MARYLAND
Photo from the U. S. Department of Agriculture.

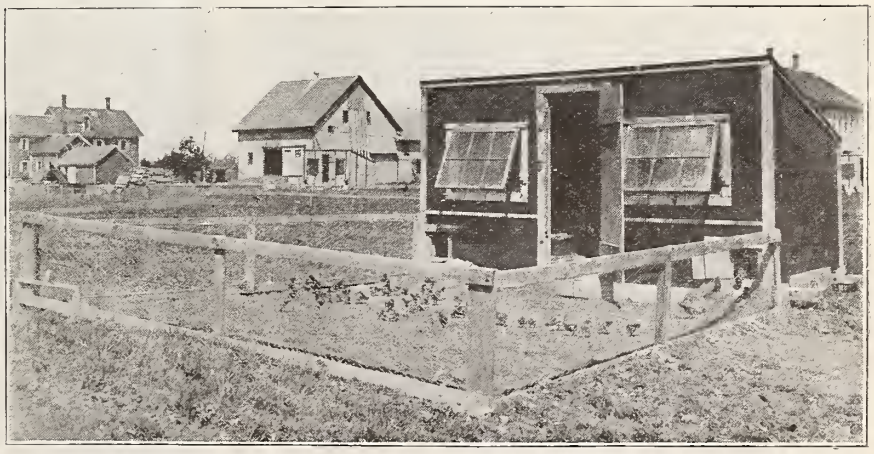
Comfort and Warmth the First Requirement

The first point to consider in caring for young chickens is to keep them comfortable. For them comfort means warmth and dryness—especially for the first few days. A hen that is hatching a brood of chicks is usually reluctant to leave the nest from the time that the eggs begin to pip until the chicks are all out, dried off nicely, and themselves begin to explore the vicinity of the nest. She will go without feed or drink rather than move at this crisis, and if she has been well fed and is in good condition she appears none the worse for a two or three day's fast. She stays on the nest and keeps the chicks snug, warm, and dry. They do not need feed for from 36 to 48 hours after leaving the egg, as the yolk of the egg, which is absorbed through the rectum just before the chick hatches, furnishes nourishment until the chick is able to get about well, and to take an interest in things that it can pick up and swallow.

The exact period for which the yolk affords sufficient nourishment has not been determined, nor is there really any need that it should be,—nor can one see how it could be done even to satisfy a natural curiosity on the point. We can learn by observation that chicks frequently begin to pick up feed when about 24 hours old; that they rarely do under 24 hours; that chicks in the same brood will begin to eat some in about 24 hours, others not for 36, or perhaps about 48 hours; and that almost all chicks that have good vitality will begin to take feed quite freely by the time they are two days old. We know also by observation that chicks can go as long as 72 hours after hatching without feed, and apparently be none the worse for it; yet we will also find some chicks that seem to be weakened if kept without feed as long as that. It cannot be positively said that the lack of feed caused weakness noted, for these cases generally occur in lots of chicks shipped after hatching, and all the circumstances of the shipment may not be known.

However that may be, while the poultry keeper who is so situated that he has to take chances on chicks that may be full three days old before they reach him and get their first feed, can do so with the assurance that the risk in keeping them without feed for so long is the least risk in transportation, this is a risk which need not be taken except in such circumstances. Ordinarily there is no occasion to keep them without feed so long, and the chicks may be fed as soon as they begin to show that they are looking for something more than warmth and comfort.

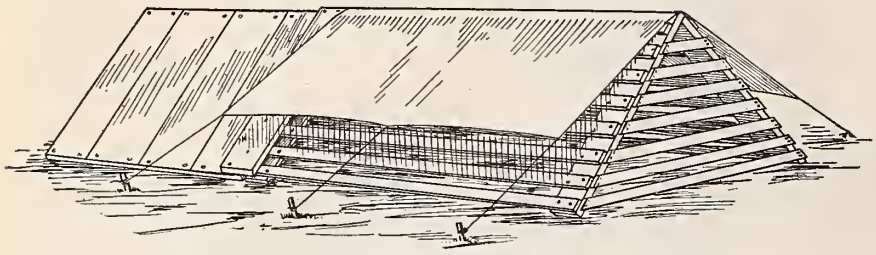
It is frequently said that chicks are injured by feeding too soon. This was maintained by many regarded as good authority when nearly all chicks were hatched and brooded with hens. It is not now so strongly held with regard to chicks under natural methods, but many assert that too early feeding must be avoided in handling chicks artificially. The circumstances upon which this opinion is based are not anywhere set forth so fully and clearly as to show that early feeding was without doubt the cause of trouble, and it would be illogical to admit that if chicks under natural methods are not injured by early feeding, artificially hatched and brooded chicks may be—with all conditions right. But while taking this position we may recognize it as entirely reasonable to suppose that there are many chickens which as a result of wrong temperature in incubation, or in brooding, have a slight tendency to bowel trouble which nature takes care of more readily if they take no feed into the system until at a suitable degree of temperature, and with rest and quiet, the organs are normal. The case here is precisely the same as when at any later period in life chickens and fowls have conditions of the digestive tract when they are



BROODER HOUSE USED AT THE MAINE EXPERIMENT STATION
The movable fence is used only to confine the chicks to space near the house while very small.

better without feed, though the condition and appetite of the birds being abnormal, they will eat feed which is really injurious to them.

Chickens that are noticeably bright and lively from the start, and have among them none that are continually giving a plaintive cheep, can generally be allowed to feed as they will at any time, and with entire safety. Those that plainly appear less vigorous, and of which any considerable number are always complaining, should not only be fed with more caution at the start, but should have special attention in every other way, for their lack of vitality may be in part due to a condition which should be and may easily be corrected. When there is anything wrong with a lot of chicks, the poultry keeper ought not to accept one possible cause as the whole cause of the trouble, but ought to consider all aspects of the case and assure himself that every other condition is right, before he concludes that the fact that he fed chicks before they were a certain age is the sole cause for some trouble which has developed among them.



A COOP WITH SLATTED RUN AND TENT FLY FOR SHADE

To the best of our knowledge the question of the possible effects of early feeding goes back to the question of keeping the chicks comfortable at this stage and is closely related to it. Where chicks are hatched with hens they usually come on all right, yet there are exceptions to the rule, due to the fact that many hens are either temperamentally or constitutionally unfit for that part of the duties of motherhood. There are hens that will not make good hatchers, because — apparently — their body temperature is below normal. While we might suppose that the temperature of such hens was still high enough for brooding, which does not require as high a temperature as incubation, the fact seems to be that these low-temperature hens instead of imparting vitality to the chicks they brood, draw it from them. Then there are hens which at hatching time and while confined to the nest are nervous and restless. They trample the chicks, kill some, and make the rest generally uncomfortable. Such disturbing treatment will easily account for a little digestive trouble. Poultry keepers using natural methods, especially those whose opinions come before the public in any form, are much more careful in selecting mothers for chicks than they were years ago, and consequently have less trouble at this stage.

With artificially hatched chicks, comfort depends on the proper operation of the incubator at hatching time and of the brooder at the start. Incubator temperatures are often allowed to run too high; there is insufficient ventilation in the machine, and the air both in and around it is too dry. Often the chicks are left in the machine a day longer than they should be, because the brooder is not ready, or brooder accommodations provided are insufficient and they are too much crowded in the brooders while more brooders are being made ready. No one intends to let such things happen, but they do often happen, and the common tendency in all parts of work with poultry is to underrate their effects upon the chicks, and to expect that what effects come from any wrong condition will pass almost as soon as it is corrected or the chicks are removed from its influence. It is a safe rule to have the brooder warmed and ready two days before young chicks are to be put into it. An experienced operator may delay until there is just time to warm it up before the chicks are ready for it, but a novice should make sure that he has ample time to readjust anything that may go wrong.

With the coal-burning stove brooders now widely used, and working very well sometimes in poorly constructed buildings, such as cheap movable houses, it is especially necessary in late winter and early spring to have no open space under the house, and to have the walls at the back and on the end that gets the coldest wind perfectly tight for two or three feet from the floor. Small cracks or chinks higher up in these or in the other walls may do no harm, and where the house is too small for the size of the stove—as is often the case—there is an advantage in a few of these small permanent ventilators; but cold wind under the floor is bad even when it is well covered with sand and chaff, for then the heat thrown to the floor by the stove and the metal hover, striking a floor cold on the other side, makes a strong circulation of air on the floor where the chicks are. This book cannot go fully into the details of brooding, but the points mentioned above are matters which in the writer's experience have been found such common causes of troubles often attributed to feeding, that reference to them here is appropriate.

Another thing to be considered before taking up the details of feeding chicks under different conditions is the relation of the first culling of chicks to results in feeding. In hatching chicks with hens there usually are from one to three chicks in those hatched from one hen that are plainly poor chicks when taken from the nest. Few broods do not have one, and not many have more than two. Many poultry keepers kill these chicks when taking the chicks from the nest. Nearly all low records of losses with chicks under natural conditions come from lots where this first culling left only chicks of strong vitality.

FEEDING TRAYS FOR DRY MASH WITH WIRE MESH TO PREVENT WASTE

In putting out a brood or a few broods, a poultry keeper who has noted how the weaklings eventually drop off or, if they linger through a season, make miserable-looking, unprofitable birds, thinks nothing of killing one in a hatch of eight or nine, or two in a hatch of twelve to fifteen. He simply forgets them and does not reckon them in his count of chicks put out. But when it comes to proportionate culling in large numbers of chicks, few are willing to do it. To take one weak chick from ten does not seem serious, but to take thirty from three hundred looks like a big sacrifice—which is a wrong way of looking at it, for the chicks that come into the world conspicuously inferior to their companions are a loss from the start, and the sacrifice is in keeping them, not in killing them. If kept, the great majority of them die in the first three weeks. Meantime they take up room which it would often be of advantage for the others to have, and they are hosts for germs of chick diseases which would give their more vigorous companions no trouble if the weaklings did not distribute them. From the point of view of good practical common sense it is better for a poultry keeper to be too severe than too lax in culling at this stage.

Feeding Chicks With Hens

Where chicks are reared with hens the easiest way is to feed them the regular meals given the adult stock, and give any special chick feeds that are used at other times. This is almost necessary if the hen is to be properly nourished and kept contented, for the hen will not often take kindly to all small-size chick feed which, for reasons that will appear in the discussion of feeding brooder chicks, must be used when large numbers of chicks are kept together. The hen mother really requires as much consideration and attention as the chicks, and it is a serious mistake—and also a common one—to treat the hen with a brood as a sort of necessary evil, to be tolerated for the purpose of supplying the chicks with heat, but beyond that to be quite neglected. Some people even go so far as to confine the hen in a small coop and stint her feed. Few hens will show all the maternal instinct the case requires under such conditions, many becoming restless and indifferent or ugly toward their chicks, and—of course—rearing chicks with hens under such conditions is not very satisfactory.

In general it is not desirable to have chicks that are to be brooded with hens, hatched earlier than they can get out on the ground. While they can be reared indoors with the hens, it is far more trouble to handle any number of them that way than in a brooder. The advantage of using the hen mother is that it permits of distributing the chicks in small lots, so that they can pick a great deal of their feed, and at the same time relieves the keeper of a good deal of responsibility in the details of care and feeding. When these advantages cannot be realized the artificial method is better. Early broods with hens are mostly broods hatched for the purpose of testing fertility in matings, or to give a few early chickens for the home table. They are an irregular and somewhat rare product, and for discussion of systematic methods of feeding it is better to take up at once the feeding of young chickens when they can be put out of doors. The time for this varies according to latitude and season. It begins in March in the South and may not come until May in the northernmost states; but throughout most of the country chicks can get out on the ground at some time in April, and experienced growers try to plan to have as many as possible of the chicks they intend to raise for early layers hatched in that month.

When the chicks can first be put out on the ground, the weather is usually alternate short periods of bright and warm, and dull, cold or wet days, and the nights are generally cold. To keep them comfortable under such conditions the broods must not be too large, and the coops must be quite substantial, and of such construction that they can be made snug, or given good ventilation, as the case requires. Nine or ten chicks are enough for one hen at this season. The fact that an ordinary hen can take care of more than that while they are quite small should not mislead a poultry keeper to give more, for the chicks grow rapidly and, should the spring be backward with cold and frosty nights, a large brood may outgrow the capacity of the hen to keep them thoroughly warm, and the result then is a reduction of vitality in some of the brood. If there is much cool weather, different chicks being exposed at different times, so many may be affected that the results are on the whole not as good as if the hen had a smaller brood. After the coming of settled warm weather, broods may be much larger. Good results are often obtained with eighteen or twenty in a brood, though breeders who want the best possible development of individual chicks usually prefer not more than fifteen.

When chicks are reared with hens it is almost invariably expected that they will get a considerable amount of feed by foraging,—at least what animal feed and green feed they need, and more or less seeds and grain. The amount they can get depends in part on the location of their coops, and in part upon the numbers put on a given area of land. As a general rule, to get the feeds indicated in such quantities that no other provision need be made for animal and vegetable feeds, land occupied by chicks must not be stocked so heavily that the grass is killed out or is much soiled. In the early part of the season warm, sheltered locations are to be preferred; for the late chicks such locations are usually too warm on hot days and the air in the coops too close and stifling on sultry nights. These considerations demand different locations for early and late chicks, and besides, the late ones ought never to be put on land that was occupied by early broods the same season.

On most farms that keep only the ordinary farm flock of fowls, there is no trouble in finding suitable locations, and in rotating the young chicks so that they will not occupy just the same spots year after year. The coop can usually be placed so that the chicks are quite convenient to feed, yet can range quite a distance, and the location changed from year to year enough to avoid soil contamination, without entirely changing the range. For instance, let us suppose that on a certain farm there is not far from the house an orchard which will afford good range for a large part of the chicks grown throughout the entire season. Up to weaning time the chicks will not need near all this range. Their coops can at first be placed comparatively close together in a section of the orchard nearest the house. As the season advances and the chicks grow, the coops can be shifted at intervals and placed each time a little farther apart until they occupy half the orchard, the birds having the opportunity to range on the other half. The soil in spots where the coops stand may then become quite foul, but the soil in that part of the orchard generally will not, while that in the other half will keep clean—the droppings left by the birds being taken up by the growing vegetation. By simply shifting the coops to this part of the orchard in the following season, and managing them in the same way, the conditions in the two halves of the orchard are reversed. This alternation can be continued indefinitely

An orchard makes an ideal place for young chickens, but any available piece of land in grass can be used in the same way. On cultivated land on which other crops are growing, coops must be placed along the edges of the field. This plan can also be used with mowing lands while the chicks are small. They will run more or less in the grass, making paths through it, treading it down a little in places, and perhaps keeping it quite short for a space near each coop, but if their numbers are limited and the coops as far apart as they need to be for the chicks later in the season, the damage to the grass will be quite insignificant. The question of placing the coops to get

COOP USED FOR YOUNG CHICKENS ON A RHODE ISLAND FARM

The hen is kept confined to the coop, the window being opened just enough to let the chicks pass in and out. As the joints between the boards are open, the ventilation is sufficient in ordinary spring weather. If it should not be, a small screen is put in the window. This is a good style of coop to use after chill weather is past, when it is desired to combine several broods with one hen.

these advantages comes up early in the season, for the poultry keeper must plan ahead. Other points relating to the combination will be taken up later.

On the small place where a few chicks are grown each year, and where the whole place is in lawn, garden, and yards for the poultry, it generally is practical to place coops for small chicks in the spring where the growth of grass or cultivation in the latter part of the season keeps the land fresh. On all farms where large stocks of poultry are grown, whether by natural or by artificial methods, it is important to have the chicks started on land that was not occupied by any poultry the preceding season. The only exceptions to this are sandy locations where droppings quickly disintegrate and are carried by the rain so far below the surface of the loose soil that impurities are rapidly removed, and slopes where the natural drainage is such that heavy rains and the removal of snow in the spring wash them quite clean.

Wherever droppings can accumulate, and marked traces of the droppings left on the land one season are plainly seen at the beginning of the next season for growing chicks, the rule of putting the chicks always on **Clean Land**—not used for any poultry in the preceding season, should be carefully observed. On heavy clay soils it is still better to have the land in cultivation or grass for two seasons between those in which it is heavily stocked with poultry.

First Feeds For Young Chickens

A generation ago it was the common practice to make mostly soft feeds for young chickens, and carefully to avoid giving them an opportunity to pick up large grains. They were allowed little grain until ten days to two weeks old, and what was given them was usually either steel-cut pin-head oatmeal, or finely cracked wheat, corn, or perhaps a little rice, with all coarse particles carefully sifted out. The soft feeds used were corn meal mashes, more often made by simply wetting the corn meal with water—either cold or hot—just before feeding, but occasionally scalded, or mixed with milk. More careful feeders, anxious to get the best results, used baked johnnycake. Generally this was made of corn meal alone, but a good many persons used for it a mixture of other mill stuffs with the corn meal. Stale bread of all kinds soaked in water or milk and then squeezed out quite dry was also widely used. Hard-boiled eggs chopped fine, and mixed with crumbs of dry bread or crackers were supposed to make a superior "first feed," and though infertile eggs were largely used up in this way, it was by no means uncommon for people who grew a few chickens, and especially for novices in growing their first highly bred poultry, to use perfectly good eggs to feed the baby chicks. This was extravagant, but not so much so then as it would be now, for in those days eggs were often quite cheap in the spring.

The use of soft feeds for baby chicks is still in common practice among chick raisers generally, but it should be clearly understood that it is not good practice to use a system of feeding young chickens in which soft feeds are given to the exclusion of the common hard feeds, or to use expensive articles on the supposition that the little chicks require delicacies, when less expensive feeds of the same character would give as good results.

For more than a quarter of a century the author has given his chicks reared with hens, as their first feed, whatever happened to come in the routine of the day's feeding for all poultry in the next feeding after the chicks were taken from the nest,—which might be at anytime from daylight to just before dark, according to how the chicks were acting, and to other demands upon his time. On this principle the first feed might be a commercial chick feed, or baked johnnycake, or the mash fed to the old birds, or whole wheat, or coarse-cracked corn, or fine-cracked corn. For some fifteen years his theory in regard to the use of coarse-cracked corn was that the baby chicks would find in it as much fine stuff as they wanted, while the hen would eat the coarser particles. Then one spring when the first chicks were started in his absence the boy in charge simply fed them the same as the hens, except that more feeds were given. As they started off well it was decided to go through the entire season with all coarse feeds. This was done, and no difference in results was noted. In good, hard cracked corn as prepared for fowls, there are few particles too large for medium-sized young chickens. In soft corn that does not crack well, but has many large uneven-shaped flakes, there is a great deal that they will leave.

When fine feeds are used, it is not because the chickens cannot take and digest much larger pieces, but because when the feed is in large pieces they can get a full feed too quickly and with too little effort. This is not a matter of prime importance in rearing them in small numbers on good range, by the natural method, but is very important—as we shall see—when large numbers are kept together and brooded artificially. For the present purpose the point to emphasize is the fact that small

chickens can eat and do well on the same feeds that are fed to mature birds. This is of great advantage to those who grow a few chickens under circumstances that admit of this method of feeding.

A Simple Standard Chick Ration

Morning—Moist mash as fed to old stock.

Middle of Forenoon—Chick feed mixture (preferably a standard commercial chick feed).

Noon—Wheat.

Middle of Afternoon—Mash—same as in the morning.

Evening—Cracked corn.

In using this ration the only thing supplied especially for the young chicks is the commercial chick feed. Considering the ration in detail we will begin with the morning mash. The composition of a simple standard mash for adult breeding stock at this season of the year will be given, but for full information on the method of making moist mashes the reader should refer to the preceding chapter.

As we are considering the case of poultry (old stock as well as chicks) on range where they get green feed and animal feed, the mash used will be an all-grain mash: 1 part of corn meal to 2 parts of wheat mixed feed, or bran and middlings (see page 39).

To a hen with a brood of ten or twelve chicks, as much of this should be given as is usually allowed per hen in feeding the adult stock. Most novices make the mistake of feeding too much at first, not realizing what small quantities are eaten by chicks just starting. Supposing that this feed is given between 6 and 7 o'clock in the morning, the chicks will each eat a little of it, but all together they will not eat enough to make much difference in the hen's allowance. She may not have all she would eat, but as she is now on a five-meal-a-day routine that will not hurt her. The hen should be in a coop with slats through which the chicks can pass freely. The feed should not be put on the ground in the coop, but either on the ground or on a board or small flat trough or dish just outside, where the hen can eat of it but cannot scratch it. If the coop is on clean grass there is no need of a feeding board.

After eating, the chicks will usually go under the hen, especially on chilly days, but when they begin to get hungry again will be likely to run about, picking at whatever attracts them and eating a little of what they find. About 9 to 9:30 o'clock they should be given about a tablespoonful of commercial chick feed. This should also be put just outside the coop. If the grass is so thick that much of it may be hidden if scattered, put it on a board or just in a little pile. Once the chickens are accustomed to eating it they will dig it out from among grass roots when scattered in them, but for the first few feeds it is as well to have it easy to get at.

About noon give what wheat would make a fair allowance for the hen, scattering it either in her coop or outside—keeping in mind that she is to eat the most of it. In the middle of the afternoon give mash, the same as in the morning, a little less if the hen does not seem keen for it. It will usually be found that the hen has a fair appetite for five meals a day, and allowing her all she wants brings her quickly into laying condition again. That is an objection or an advantage according to how she is handled. Particulars on that point will be discussed a little farther on. Toward dusk give cracked corn—a fair allowance for the hen.

For the first few days the chicks take very little at a time. The amount they eat of any meal given is so much less than most persons would estimate as what the chicks should have in addition to the hen's allowance, that hardly one person in a hundred feeding a hen with a brood fails to put out about twice the feed needed. The best working rule is to forget that the chicks require any specific amount, and just feed the hen, letting the chicks take what they want of her ration. After a week to ten days the chicks begin to take enough so that the feeder sees that the hen needs more than he has been giving, and from this time on the increase necessary for the growing chicks is easily determined.

The water for a hen and brood should be outside the coop, but where the hen can reach it. Vessels of the "fountain" type that the chicks cannot get into, are not as essential as for larger lots of chicks, but are most convenient. If open pans or saucers are used they should be shallow. Then if the chicks do get in them the down is not wet. With fountains, watering once a day should be enough. With open vessels the number of waterings depends upon how much dirt gets into them. On clean sod once a day may be enough. It is not advisable to give milk in open vessels, or in any vessel that gives the chicks a chance to smear each other with it when drinking. Notwithstanding the recommendations sometimes given for milk for young chicks, the writer considers that its use should not be allowed if thereby the chicks are smeared and the down made rough and the chick uncomfortable and miserable looking. Some may suppose that the chick is none the worse for that, but a mussed-up lot of chicks never looks thrifty, and it may reasonably be doubted that the milk taken with this result contributes more in nutriment than is taken away in discomfort. Milk should either be fed so that the chicks are not soiled with it, or given in the mash, or withheld until they are large enough to drink it without as much soiling as when small chicks have it in ordinary vessels.

METHOD OF COOPING YOUNG CHICKS WITH HENS AT LESTER TOMPKINS' FARM, CONCORD, MASS.

The young chickens here are always put first on grass land on which no poultry was allowed to run in the previous year.

For small broods on range the ration described above gives ample variety. In fact, if the range is a good one, the ration could be of mash and cracked corn—as far as the chicks are concerned—and they would grow as well as on any carefully compounded ration that could be devised for them. The hen, however, confined to her coop would soon become very fat. The coop should be moved its own width or length once every three or four days, any droppings that can be easily taken up being removed from the ground, especially if it is intended that after a few shifts the coop will go back to its first position and make the circuit a second time.

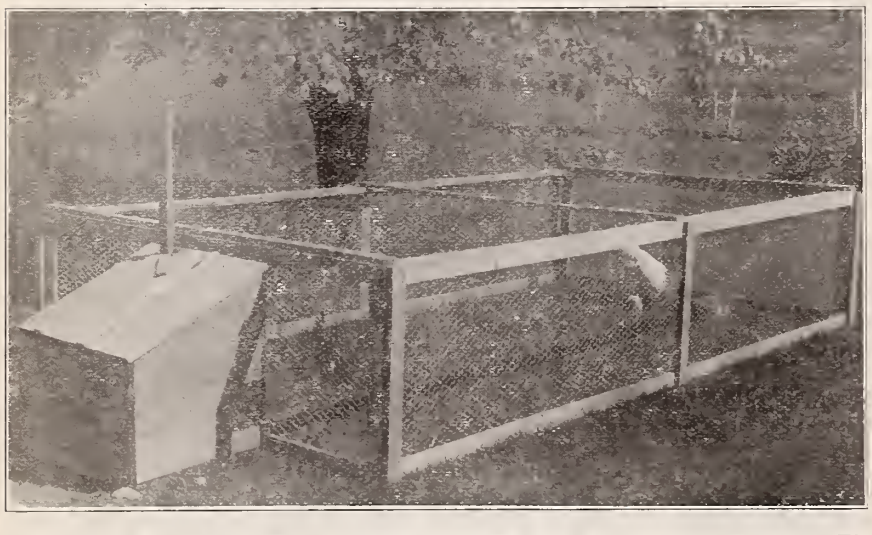
With early chicks, the hen should always be confined to the coop until the chicks are weaned. In no other way can we be sure that the hen will brood the chicks as long as they need brooding. When a hen hatches a brood of early chicks and is allowed to run with them, and is well fed, she is almost certain to begin to lay before they are feathered, and most hens that begin to lay when at large with chicks soon drive the chicks from them and go back to the old flock. Not one hen in a hundred that is kept confined with her brood, and not allowed to associate with any other fowls will refuse to brood them after she resumes laying. On the contrary, though not so solicitous for their chicks as before, hens handled this way will often lay almost daily for weeks and brood the chickens readily at night, even if they refuse to do so in the daytime. With late broods it is not so important for the hen to attend to brooding when chicks are three or four weeks old. They may get along very well by themselves, yet it will always be found that, when the period of the hen's brooding is so short, her brood is more backward all through the season than those that have had proper brooding until well feathered.

Variations in Feeding Chicks With Hens

The ration that has been discussed provides an alternation of soft and hard feeds. Such a ration does not start chicks off as fast as one of nearly all, or all soft feeds, but it builds up the digestive system, and chicks fed by this method can consume larger quantities of feed to advantage and use more rough feeds in the later stages of growth than those which by heavy feeding of soft feeds make remarkable growth at the start. For stock birds, either for laying or breeding, the system that builds up a strong organism with power in every function is the best. For growing poultry to be marketed at an early age the other method may be better.

The feeds are given on page 49 in the order in which they are most commonly fed. It really makes no difference about the order of the meals, except that, in general, the chicks will show the best appetites for the feed in different forms if hard and soft feeds are alternated. If johnnycake is used instead of mash, or in place of mash and of one other feed, the system instead of including two soft and three hard feeds, would have three soft and two hard feeds. This would be more desirable if commercial chick feeds were not used, or if the cracked corn obtainable were at all inferior in quality. It should not be assumed that because small chicks will eat and will do well on a ration that includes some feeds of grain as fed to adult fowls, the matter of giving them things especially prepared for them can be entirely put aside. The practical point is to strike a happy medium between the common ration for mature poultry, and the methods of chick feeding which call for different rations for the chicks at every meal.

For chicks in confinement, or on limited range, both green feed and animal feed should be provided from the first. Many instructions for feeding chicks defer feeding these things for a week or ten days, or even more,—giving the impression that earlier feeding of them is detrimental. Such opinions appear to have arisen from the common practice of postponing the giving of other than the "baby feed" most easily obtained as long as it was possible for the chicks to thrive on a limited diet. Before oat sprouting came into general use, suitable green feed for early chicks was extremely scarce. Poultry keepers used to grow a little lettuce, or sprout a little grain in a small box, to give the chicks an occasional taste of green feed, but the amount so provided was generally insignificant in comparison with the wants of the chicks. Green feed being so difficult to get, it was customary to put off feeding it until the chicks were really suffering for want of it, and then to give it more as a medicine than as a feed. When we put chicks on good range in the spring, giving them ideal conditions, the ration we have discussed in detail is supplemented from the start by grass and other tender green feed in considerable variety, and by worms and insects. When there is not a range for chicks that affords these things, the poultry keeper must supply them as fully as is practical and economical.



COOP RUN TO USE WHERE CHICKENS MUST BE PROTECTED FROM CATS

This run is 6x12 feet on the ground and 2 feet high, and is made with the sides and ends hinged so that it can be folded up when not in use. That construction works well while the hinges are new, but hinges not used soon rust and become immovable. The best way to make this coop is with top and sides and ends separate panels to be held together when in use by eight-penny fine nails. Only ten or twelve nails are needed to make the coop stiff enough to move about as desired, and a coop of this size is much easier to handle in separate pieces.

What is practical and economical depends in part upon the circumstance and the purpose for which poultry are grown, but also very much upon the ingenuity of the poultry keeper, and his ability to secure early and continuous supplies of green feed from quite limited space outdoors, in the season, in addition to making use of the oat sprouter for the earliest chicks. The writer has seen as good chicks as were ever grown under the most ideal conditions produced year after year in small bare yards, but at a cost in

time and labor far beyond what was profitable when the time could be used otherwise at any ordinary rate of compensation. In some cases this was judicious for the poultry keeper gave only leisure time, but in others interest in the chickens and the determination to leave nothing undone that would contribute to their perfect development led to such neglect of a major occupation that the net result was a steadily diminishing income from a regular occupation, which was not offset by the better results secured from poultry.

While it is desirable to give chickens all possible advantages, it is useful to know that we can grow good chicks—though not the best—without some of these advantages. Unstinted supplies of green feed are of great benefit to growing chicks, but when they are not to be had without extraordinary effort or expense we can grow good chickens by giving them just enough to tone them up a little and keep the digestive organs from suffering the effects of a too-heavy grain ration. When this plan is followed the effort should be to have small supplies of green feed daily rather than larger amounts at less frequent intervals. The situation is greatly helped by the use of clover or alfalfa meal in mashes for the chicks. When these articles are from hay that was cured green and are really of first rate quality they are a good substitute for fresh green stuff. The problem of supplying animal feed is much simpler for the prepared meat feeds are so highly concentrated that small quantities will substitute for the animal feed commonly secured on range.

WIRE COVERED FRAME TO KEEP LARGE FOWLS FROM FEED OF SMALL CHICKS

Photograph from U. S. Bureau of Animal Industry.

Feeding Chicks in Brooders

In feeding brooder chicks, with rarely less than fifty in a lot, and the ordinary small lot containing a hundred or more, and the broods on large plants from two hundred to five hundred or more, many things must be done quite differently from the practices that will answer very well in handling small broods with hens.

In the first place, the chickens have no mother to in any way take an interest in them, and are in such numbers that even when they have some range they quickly strip it of all edible things close to the brooder—which range would supply a small brood with feed accessories for an indefinite time. So the large group of chicks has no inducement to keep busy looking for feed on the outside range near the brooder, nor does that land afford them the variety it would to a few of their number. Where a small brood of chicks could eat a fair meal of such hard grains as are fed to older birds, and then busy themselves picking up feed of various kinds on their range, the large group—if fed grains that the chicks can eat quickly—will get little else, and the chicks, being naturally inclined to activity, and having so limited a variety of feeds in the large grain, begin to pick at anything and everything in their reach. They pick at each other, and if a chick is listless and instead of resenting it or moving away when picked submits to it until the others start the blood, they soon kill it and develop the habit of cannibalism which causes so much trouble sometimes in growing chicks in brooders.

If a chick is soiled about the vent, or if the down anywhere is plastered together—as it sometimes is when a chick does not dry off well at hatching, or when they have access to milk or a soft, sticky mash, or any substance with which they become smeared while feeding on it, that condition seems to tempt the chicks to peck at each other and as soon as blood is drawn the victim becomes a prey of his little companions. Brooder chicks will sometimes eat building paper when their coop is covered either outside or inside with material of this kind that they can nibble off. In general this does them no harm, and if their ration is a concentrated one the paper they take may be as beneficial in diluting it as the indigestible fiber in any of the common feeds; but when chicks resort to such practices, they do not stop with the destruction of all paper within reach. That of itself is wasteful, for it must be replaced at considerable cost of labor, if not of material, but chicks with abnormal appetites and habits are subject to all sorts of vices—cannibalism, feather-eating, eating droppings, etc.

The practical way to prevent these things is to keep the chicks interested in their proper feed. This is done, almost automatically, by giving the grain so finely broken that even when it is fed in troughs the chicks have to spend a good deal of time to fill their crops with it. With such finely cracked feed the advantage of alternating hard grain and soft feeds is not as apparent as when the grain is fed in coarser form; and if the fine feed contains seventy to eighty per cent of one grain—as corn or wheat, with the remainder a variety of grains, some cracked peas, and a little granulated meat scrap, chicks may be fed exclusively on this mixture, and a light supply of sprouted oats, for the first two or three weeks. This is probably as nearly a "fool-proof" method of feeding brooder chicks as can be devised.

As the chicks grow larger, and are able to forage for quite a long distance—after spring opens, there is not as great need of giving feed in form that will keep them busy, and they are also more indisposed to pick up the fine particles. Then they are given a coarser mixture of grains, commonly described as an intermediate chick feed, and later on are given the ordinary mixtures as used for adult poultry. The ages at which these changes are made vary somewhat with different feeders. The list of rations to be given farther on will show the different practices.

When homemade mixtures are fed, the variety in the grains is usually more limited, and the poultry keeper needs to give more care to the supplying of extras that give more variety to the ration. The advantages of giving some soft feed will usually be more marked when there is little variety in the mixture of broken grain fed. Dry

mashes used for adult birds may be given to chicks, if reasonably free from coarse meat scrap and from oat hulls. For novices handling brooder chicks it is generally safest to use either all dry feeds or to have the soft feeds well cooked. Dry feeds tend to correct looseness of the bowels which often results from chickens becoming too warm or too cold, and which is likely to be increased rather than diminished by the feeding of moist mash as commonly prepared by inexperienced poultry keepers. Those who wish to use moist mashes for brooder chicks ought first to make themselves proficient in making moist mashes that laying hens will eat freely, with good results in egg production, and keep in continuous good condition. When one can do that, he is warranted in trying moist mashes on his chicks to secure the greatest consumption of feed and the best growth. Until he has demonstrated his skill with hens it is safer to omit moist mashes and take the best results that can be obtained without them. If the moist mash is not made right and used right, the dry mash gives the highest average and most uniform results and the least loss.

Where chicks are confined to the brooder house, or have access only to yards so small that they do no more than afford outdoor air and a little more room for exercise, they should have feed before them practically all the time. The number of times it is necessary to give the feed depends on the size of the brood and the arrangements for feeding. It is possible with small broods to arrange so that feeding and watering need be done only once a day. That plan is not advised except for those who grow only a few chicks, and who must be away from home much of the time, and so can not give them close attention. It involves risks of either shortage of feed or waste in feeding that people who have to make their poultry pay do not habitually take. However, where it is necessary to do this—either regularly or occasionally—any method that places a sufficient supply of feed where the chicks can get it will answer.

The covered feeding pans for dry mash, with holes around the edge of the cover through which the chicks can eat the mash; or troughs (for either dry mash or fine-cracked grain), from which the chicks can feed, but in which their droppings do not fall to any considerable extent; and fine grain scattered in litter on the floor of the brooder house, will provide feed accessible at all times. With a drinking fountain of the size required for a day's supply of water, all that the chicks need for nourishment can be put in the house at one time. This of course could be done for a flock of any size, but it is not commonly done because when there is someone about to attend to the chicks at intervals through the day it is more satisfactory to give feed at several different times.

Where the feed will not lie more than a few hours before being eaten it is not so necessary to protect it from the droppings, for the greater part of it will be eaten within a short time after it is given, and what remains is mostly consumed before it has lain long enough to be much fouled by contact with droppings and chickens' soiled feet. The longer feed lies exposed to such contacts and to the air, the less appetizing it is, and if the supply is liberal (as it must be when the intervals between feedings are long) the tendency is for the chicks to scatter it if possible, and to pick it over for the bits of meat in it, or—apparently—sometimes in search of something their ration lacks; for the instinct of the chick seems to prompt it to do this. Exposure and picking the feed over result in more or less waste, with less actual consumption of feed than when it is given fresh from three to five times a day. Also in feeding in vessels that protect the feed from fouling, and in keeping a littered floor in the right condition to protect the feed and compel a reasonable amount of exercise, the time required for one feeding is as much as for two or three feedings in open troughs or on a sanded floor, or in a light litter.

Then again, the feeding is but one thing for which a poultry keeper makes frequent rounds of his brooders. The heaters must have attention twice daily, and may need it oftener. Ventilation of the house is likely to call for attention later in the morning and earlier in the evening than the regular hours for attending to heaters. The potential value of the chicks far exceeds their actual value—though in the case of a large stock of chicks that is considerable; and to get the chicks started right means much to the poultry keeper who depends upon them for his living. Therefore, while they are small he considers it good policy to keep such close watch over them that nothing can be wrong for more than a short time without being seen and put to rights. Taking this attitude of watchfulness over his chicks the careful poultry keeper does not regard five or even six feedings a day merely as routine of feeding not absolutely necessary, but considers the advantages of frequent feedings in connection with the advantage of frequent inspections to make sure that all is well.

A poultry keeper who takes this position—and most experienced and successful growers of poultry on a large scale do—will not adopt a definite schedule of meals evenly dividing the day; but considering all occasions for making the rounds of the brooders each day, will adjust some of the feedings to other necessary routine, and as far as possible combine the tasks that there is occasion to do at nearly the same time. In general, the larger the broods of chicks the more necessary it is to watch them closely. More things can go wrong in a large brood; there are more chicks to "start something" which ought to be stopped before the whole lot engage in it. All the evils of chicks massing and crowding when frightened or chilled increase with the size of the flock. A poultry keeper who has had some disasters that would have been either avoided or greatly mitigated had he been promptly on the spot, learns to keep close watch on everything relating to the welfare of his young chickens, and in following this policy he finds it convenient to feed at frequent intervals.

Brooder Chicks With Good Range

The advantages of close oversight of chicks in brooders during the first few weeks cause most poultry keepers who grow large numbers of chicks to prefer to have the brooder houses quite close together while the chicks require heat, rather than to attempt to give the benefit of range at this stage, though a good range may be available. They consider the saving in time in making each round of the brooders in these few weeks as of more importance than the extra work in providing green feed. There are, however, many places where the number of chicks reared each season can be handled in a single brooder using a coal burning heater, or in a few such brooders. When this is the case it may be entirely practical with certain easy restrictions, to give brooder chicks much the same advantage of range that would be given chicks with hens on the same land.

Small chicks in brooders cannot be allowed full freedom to wander at will as may safely be done with chicks whose hen mothers are cooped; but after they are four or five days old they certainly should be allowed the run of small yards at the brooder

house. These may be either permanent yards, or temporary enclosures used only for these few days. If the house is to be kept always in the same location it is as well to have permanent yards. If it is to be moved every season a temporary yard of movable panels, or simply of inch-mesh poultry netting eighteen to twenty-four inches wide, attached to short stakes driven into the ground, may be used for the purpose. All that is needed is to keep the chicks close to the house, where they can easily be driven in if there is occasion to do so, until they have learned to go to it for warmth when they feel cold, or for safety if anything disturbs them. Once they are broken to this they may be given unlimited freedom of any place that would be safe for chicks with hens.

Brooder chicks at liberty will require a little closer watching at first than chicks with hens, for without the note of the mother hen to recall them when they get a few rods away, some chicks may wander so far from the brooder that they will not get back by themselves. For the first few days after chicks are given full liberty the attendant should keep an eye on such stragglers. Usually they wander off in small groups, and when they get more than eight or ten rods from the house he should drive them part way back to it. When driven back a few times they usually will make their own way from any distance, but if occasionally one fails to do so, and is lost, that should be accounted only an ordinary risk of giving the chicks freedom and range, and the few losses are more than made up in the better condition and thrift of the whole flock, and in the relief of the attendant from some of the more troublesome details of feeding. Brooder chicks in flocks of two or three hundred could be given good range on many farms without placing the brooder house so far from the residence that attendance would be inconvenient. In many cases several such colonies—occasionally perhaps five or six of them, could be placed in a circuit at no point far from the dwelling, yet with the chickens ranging mostly on the area beyond their houses, and thus foraging over a large area, while the attendant in feeding and caring for them had to make a comparatively small circuit. The principal obstacle to this on the ordinary farm is that the land and range most convenient for young chickens handled this way are commonly monopolized by the old stock. That indeed is the great obstacle to the development of the poultry carrying capacity of most general farms. Whenever a farmer adopts a system of poultry keeping that puts his old stock on outlying land during the season it can be outdoors, and leaves the inner ranges for the young chickens during the first half of the growing season, transferring most of them also to outlying fields after they are about half grown, the poultry capacity of his farm will be greatly increased, and he will find poultry one of the most profitable branches of farming.

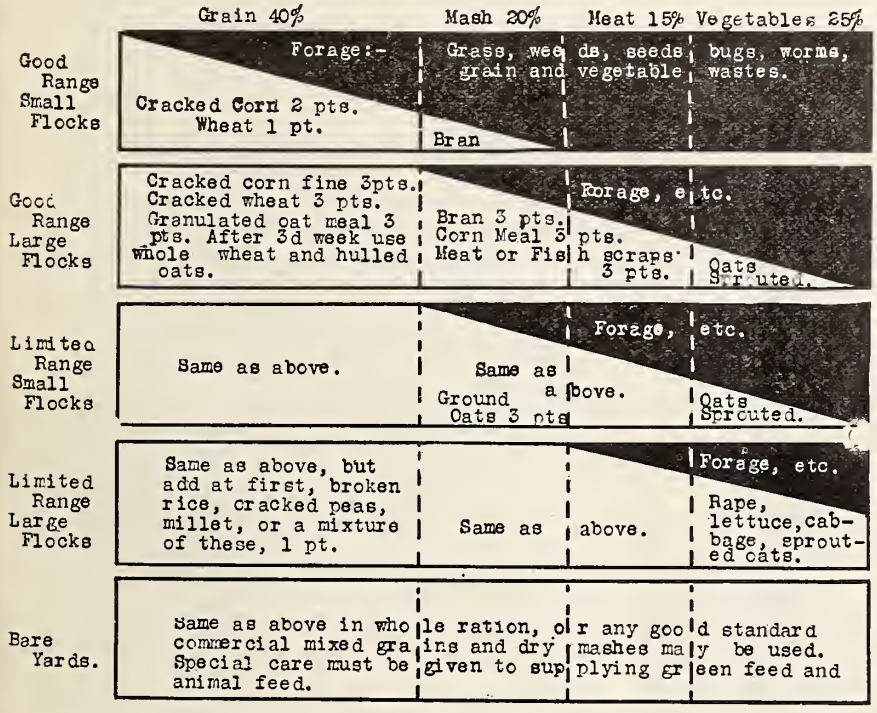


DIAGRAM SHOWING GRAPHICALLY WHAT PROPORTIONS OF THEIR FEED REQUIREMENTS CHICKS MAY GET BY FORAGING UNDER DIFFERENT CONDITIONS, AND A STATEMENT OF WHAT MUST BE SUPPLIED IN EACH CASE TO MAKE A COMPLETE RATION

Explanation—The five equal rectangular figures represent the total feed requirements, which are the same for all cases. The perpendicular dotted lines divide all figures alike, proportionately to the ordinary percentages of the different forms of feed to the whole ration. The black portions indicate the proportion of their requirements which the chicks may supply by foraging under the conditions specified. In the appropriate columns in the white portions of the figures are given simple model rations, which with the feed obtained by foraging will make a well-balanced ration. Pt. and Pts. in the diagram mean parts by weight. The diagonals separating the white and black portions of the figure are determined by joining the highest point of supply for a large flock under the same conditions, taken at the bottom of the figure. Thus in the upper figure: a very small flock, on good range, might not need any feed given at all. A large flock would get all the green feed and animal feed it needed (otherwise the range would not be good) but would have to have some grain, and perhaps a little dry mash. A large flock on limited range, does not get enough in foraging to make any practical difference in the ration fed.

Special Rations For Brooder Chicks

As stated in the discussion of commercial poultry feeds in Chapter II, the standard brands of commercial mixed feeds are increasingly used for young chickens because their quality is more reliable than that of ordinary supplies, and because to a great extent the manufacturers of these feeds forestall others in buying the miscellaneous seeds most available for giving variety to mixed-grain rations. When these standard goods are fresh and their original quality unimpaired they are usually the safest feeds to use for brooder chicks, and when fresh supplies of these goods can be obtained, the majority of large growers prefer them at least while the chicks are small and confined to limited areas.

There are, however, two points in connection with the use of commercial feeds which make it advisable for a poultry keeper to be sufficiently familiar with the composition of good homemade rations to be able to prepare such from any material that may be at hand should the occasion arise. Supplies of a good brand sometimes fall short, either from an extraordinary demand, or from delays in transportation. Then it happens quite often that a local dealer carries a surplus over from one season to the next, and either from long holding or from storage under improper conditions this becomes stale and injurious to

chickens. A poultry grower who finds a standard commercial feed not giving its usual good results often erroneously concludes that the manufacturer is putting out an inferior article, when the only trouble is that the particular lot he has is stale.

It is not always possible in such cases to get fresh supplies at once. In any case of shortage a poultry keeper should be able to provide without delay a suitable substitute to use until fresh stock of the commercial feed he uses arrives. There are also many cases where local grown feeds of superior quality are available for the whole or a part of a ration. In addition to these cases of necessity, there are many poultry keepers to whom the details of feeding are a matter of such interest that they prefer to make their own feed mixtures, and like to try out any ration reported as having given satisfactory results. So while the tendency of the time is to an increasing use of commercial feeds, the considerations stated and the fact that actual proficiency in poultry keeping requires some familiarity with a variety of rations, make formulas for homemade rations of general interest. The following selection includes rations used in all localities and practically all desirable combinations.

Ration No. 1—Model Variety Ration Recommended By the United States Department of Agriculture

SCRATCH MIXTURE:

Cracked corn	5 pounds
Cracked wheat	2 pounds
Pinhead oatmeal or hulled oats	2 pounds
Broken rice, cracked peas, millet, rape, or a mixture of these	1 pound

Feed morning, noon and night, scattered in chaff litter.

Feed middle of forenoon and afternoon, johnnycake No. 1, page 43.

Give any tender green stuff, and keep constantly supplied with fresh water.

Ration No. 2—Ontario Agricultural College Ration

SCRATCH MIXTURE:

Cracked wheat	25 pounds
Granulated oatmeal	15 pounds
Millet	12 pounds
Small cracked corn	10 pounds
Small cracked peas	6 pounds
Broken rice	2 pounds
Rape seed	1 pound
Grit (chicken size)	10 pounds

Feed five times a day for the first three days. Then give three feeds of this a day; and one feed of bread and milk—the bread being squeezed dry and crumbled; and one of whole wheat, or a mash made of equal parts of bran, shorts, and corn meal, to which has been added 10% of animal meal or blood meal.

Give for green feed lettuce, rape, cabbage, or sprouted grain.

Ration No. 3—Cornell Ration for Chicks—(Determined As a Result of Numerous Experiments With Different Rations)

The Ration	The Method
Mixture No. 1: 8 lbs. rolled oats. 8 lbs. bread crumbs or cracker waste. 2 lbs. sifted meat scrap. 1 lb. bone meal.	One to five days—Mixture No. 1, moistened with sour skimmed milk, fed five times a day; Mixture No. 2 in shallow tray containing a little of No. 3 (dry), always before chicks. Shredded green feed and fine grit and charcoal scattered over feed.
Mixture No. 2: 3 lbs. cracked wheat. 2 lbs. cracked corn—fine. 1 lb. pinhead oatmeal.	Five days to two weeks—No. 2 in light litter twice a day; No. 3 moistened with sour skimmed milk, fed three times a day; No. 3 (dry) always available.
Mixture No. 3: 3 lbs. wheat bran. 3 lbs. corn meal. 3 lbs. wheat middlings. 3 lbs. meat scrap. 1 lb. bone meal.	Two to four weeks—As above except that the moist mash is given twice a day.
Mixture No. 4: 3 lbs. whole wheat 2 lbs. cracked corn. 1 lb. hulled oats.	Four to six weeks (or until chicks are on range). Reduce meals of moist mash to one a day; Mixture No. 4 in litter twice a day; dry mash always available.

Provide fine grit, charcoal, shell, and bone from the start. Give grass range or plenty of green feed. Have fresh, clean water always available.

Ration No. 4—New Jersey Experiment Station Ration

SCRATCH MIXTURE:

Fine cracked corn	40 pounds
Fine cracked wheat	40 pounds
Rolled oats	20 pounds

For the first two weeks feed four times a day, and also keep wheat bran always before the chicks in open pans or small feed hoppers.

After the second week feed the scratch mixture three times a day, and substitute for the wheat bran the following dry mash, to be kept before the chicks all the time:

Wheat bran	50 pounds
Gluten feed	10 pounds
Corn meal	10 pounds
Ground oats	10 pounds
Meat scrap	10 pounds
Granulated bone	10 pounds

Fresh water should be kept before the chicks at all times and an abundance of succulent feed given.

Ration No. 5—Ohio Agricultural College Ration

SCRATCH MIXTURE:

Fine cracked corn	60 pounds
Cracked wheat	40 pounds

MASH:

Corn meal	40 pounds
Wheat middlings	20 pounds
Wheat bran	20 pounds
Meat scrap	15 pounds
Bone meal	5 pounds

Feed the scratch mixture morning, noon, and night. The mash may be fed either wet or dry. If fed wet give it in the middle of the morning and of the afternoon. If fed dry keep it before the chicks all the time. Give also water, sour milk, green feed, grit, oyster shell.

Ration No. 6—Massachusetts Agricultural College Ration

SCRATCH MIXTURE:

Cracked corn	10 pounds
Cracked wheat	10 pounds
Hulled oats	5 pounds
Cracked rice	2 pounds
Millet	1 pound

Feed three times a day. Twice a day give—for the first two weeks—a mash made of raw, infertile eggs mixed with rolled oats and a little bran. Three eggs to one quart of meal and bran is about the right proportion. After two weeks give a wet mash consisting of one part each by measure of wheat bran, corn meal, and middlings, and one-half part of meat scrap. For green feed give lettuce, green clover, lawn clippings, alfalfa, dandelions.

Ration No. 7—Maine Experiment Station Ration

Infertile eggs are boiled for half an hour and then ground in an ordinary meat chopper, shells included, and mixed with about six times their bulk of rolled oats by rubbing both together. This mixture is fed for two or three days. It is given with chick grit on the brooder floor on short cut chaff or clover. Beginning about the third day the chicks are fed this scratch mixture:

Cracked wheat	15 pounds
Granulated oatmeal	10 pounds
Fine cracked corn	15 pounds
Fine cracked peas	3 pounds
Broken rice	2 pounds
Chick grit (limestone)	5 pounds
Fine charcoal	2 pounds

This is fed as soon as the chicks can see to eat in the morning, care being taken to limit the quantity so that they will be hungry when the egg mash is fed at 9 a. m. This mash is fed in tin plates with low rims. After about five or ten minutes the plates are removed. At 12:30 the hard grain mixture is fed again; at 4:30 or 5 o'clock they are fed all the egg and rolled oats mash they will eat in half an hour. When the chicks are about three weeks old the oats and egg mixture is gradually displaced with this mash:

Wheat bran	2 pounds
Corn meal	4 pounds
Low grade flour	2 pounds
Linseed meal	1 pound
Fine meat scrap	2 pounds

This mash is mixed with just enough water to moisten it. For green feed give sprouted oats.

Ration No. 8—Wisconsin Experiment Station Ration

Give chicks sour skim milk in an earthenware fountain when they are twenty-four hours old, keeping this before them until they are seventy-two hours old; then give chick feed in a litter of chopped clover or alfalfa. Scatter chick feed over the litter at least five times a day. On the following day and the day after give a light feed of moist mash made of equal parts of corn meal, rolled oats, bran, and middlings, moistened with sour milk. Remove any mash that is not eaten after ten or fifteen minutes. Continue this mash for about three weeks, then gradually drop the rolled oats from the ration, and add medium-sized corn a little at a time as the chicks learn to eat it.

When the chicks are two weeks old a small hopper is filled with a dry mash of two parts of ground corn, two of bran, and one of middlings. Another hopper is filled with a fine grade of meat scrap and the chicks have access to these at all times. Green feed, grit and water are always before them.

Ration No. 9—Minnesota Experiment Station Ration

SCRATCH MIXTURES:

a—Wheat	20 pounds
Cracked corn	20 pounds
Millet	10 pounds

b—Cracked wheat ..... 30 pounds
Cracked corn ..... 30 pounds
Granulated oat meal ..... 20 pounds

Feed one of the above mixtures three times a day. Twice a day give one of the following mashes:

a—Equal parts, by weight, of finely ground corn, bran and shorts, mixed crumbly with sour milk.

b—Hard-boiled eggs, mixed shell and all with four times their weight of dry bread crumbs.

c—Johnnycake—One pint corn meal, one-half pint bran, one teaspoonful meat meal, one egg, one teaspoonful soda; mix with one-half pint of water and bake two hours. Crumble this when feeding.

Give for succulent feed, when they cannot run outside, finely chopped lettuce, a piece of potato, turnip, or beet.

Ration No. 10—Purdue Experiment Station Ration

SCRATCH MIXTURE:

Fine cracked corn ..... 2 pounds
Cracked wheat ..... 2 pounds
Steel cut oats ..... 2 pounds

This is fed five times a day for the first week. After that the following mash is given—at first twice a day, but after the chicks become accustomed to it, it is kept before them all the time:

Bran ..... 2. pounds
Shorts ..... 2. pounds
Corn meal ..... 2. pounds
Ground bone ..... .8 pound
Charcoal ..... .15 pound

Green feed, grit, and skim milk in abundance. Either sprouted oats or chunks of sod used as green feed. As the chicks approach weaning age cracked corn and whole wheat are gradually substituted for the fine mixture.

Ration No. 11—Oklahoma Experiment Station Ration

For the first few days give five times a day a mash of hard-boiled eggs mixed with a little bran and charcoal. After the first few days give two or three times a day the following:

SCRATCH MIXTURE:

Cracked wheat ..... 10 pounds
Fine cracked corn ..... 10 pounds
Steel cut oats ..... 10 pounds

As the chicks grow older substitute for the egg mash this dry mash:

Bran ..... 10 pounds
Shorts ..... 10 pounds
Corn meal ..... 5 pounds
Meat scrap ..... 5 pounds
Charcoal ..... 2½ pounds

Feed sour milk if available, giving the chicks all they will consume.

For succulent feed give sprouted grain, steamed alfalfa, cabbage, or mangels.

Ration No. 12—Missouri University Ration

MIXED FEED:

Rolled oats ..... 16 pounds
Bread crumbs ..... 16 pounds
Boiled egg ..... 2 pounds
Bone meal ..... 1 pound

Run these through a meat chopper, cut very fine and feed five times daily on a feeding board. Continue this for a week, giving sour milk or buttermilk in addition to water to drink. For a scratch mixture give a good chick feed. After a week or ten days substitute for the above mixture this dry mash:

Bran ..... 10 pounds
Middlings ..... 10 pounds
Corn meal ..... 10 pounds
Fine meat scrap ..... 5 pounds
A handful of bone meal to a pail of feed.

After the first week green feed such as cabbage, lettuce, etc., should be fed. The dry mash is kept always before the chickens, and one feed of the same mash moistened is given daily about 4 o'clock in the afternoon. When the chicks are three or four weeks old coarser grains such as wheat, cracked corn, and kafir corn may be substituted for the chick feed.

Ration No. 13—Manitoba Agricultural College Ration

First feed—Bread soaked in milk, pressed dry, mixed with hard-boiled egg and a little finely cut onion tops. Give chick feed, scattered in litter or on the ground five times a day, or in place of this wheat screenings and finely cracked corn. After two weeks give this dry mash:

Corn meal ..... 10 pounds
Low grade flour ..... 10 pounds
Bran ..... 10 pounds
Meat scrap ..... 3 pounds
A little bone meal and powdered charcoal.

Feed this dry in a pan or trough twice a day. If desired this mash may be used from the time the chicks are put in the hover. If milk is available give in a drinking fountain.

Ration No. 14—Michigan Experiment Station Ration

SCRATCH MIXTURE:

Millet ..... 1 pound
Kafir corn ..... 1 pound
Cracked wheat ..... 2 pounds
Cracked corn ..... 2 pounds
Pinhead oatmeal ..... 2 pounds

Feed this scratch feed several times a day, in thin litter at first, gradually increasing the depth of the litter as the chicks grow until it is four or five inches deep. With this give, either moist or dry, the following mash:

Granulated milk ..... 1 pound
Corn meal ..... 1 pound
Bran ..... 2 pounds

If sweet skim milk is obtainable the bran and meal may be fed dry, the milk given as drink.

Ration No. 15—North Carolina Experiment Station Ration

SCRATCH MIXTURE:

Cracked wheat ..... 2 pounds
Fine cracked corn ..... 1 pound
Oat meal ..... 1 pound
Millet ..... 1 pound

Feed four times a day, supplementing with one feed of johnnycake, baked thoroughly and then crumbled with boiled egg in the proportions of one part egg to four of johnnycake. After two weeks substitute a dish of meat scrap for the bread and egg. Continue the fine grain mixture until the chicks will readily eat the larger grain as fed to fowls. If the chicks have all the milk they will drink the meat scrap may be omitted.

Ration No. 16—Montana Experiment Station Ration

SCRATCH MIXTURE:

Cracked wheat ..... 15 pounds
Fine cracked corn ..... 15 pounds
Fine cracked peas ..... 15 pounds
Cracked barley (bald) ..... 10 pounds
Broken rice ..... 2 pounds
Chick grit ..... 5 pounds
Oyster shell (fine) ..... 5 pounds
Crushed bone (fine) ..... 5 pounds
Fine charcoal ..... 2 pounds

For the first two days the chicks are given only a little dry bran, in shallow pans, five times a day. After the second day two of the feeds of bran are replaced with the above mixture. Beginning with the third week the amount of this is much increased, and the chicks are also allowed free access to the following dry mash kept in hoppers:

Bran ..... 10 pounds
Corn meal ..... 10 pounds
Barley meal ..... 10 pounds
Ground oats ..... 10 pounds
Shorts ..... 10 pounds
Meat scraps ..... 10 pounds
Salt ..... 20 ounces

Until out on range the chicks should have sprouted oats. Water, oyster shell, grit, and charcoal are kept before them all the time.

Ration No. 17—Oregon Agricultural College Ration

a—First feed—Rolled oats, or bread crumbs soaked in milk, or finely cracked wheat and corn. For the first day keep the rolled oats, or whatever is fed, before them all the time, but after they have learned to eat, better results will be obtained by feeding four or five times a day all they will clean up in a short time. Cheaper feeds may be substituted after the first few days. Cracked corn or cracked wheat, or both, should form the basis of the grain ration. The chicks must also have animal feed, green feed, and grit. Skim milk is hardly concentrated enough to furnish the necessary animal feed. Milk is better fed clabbered, or made into cottage cheese. A daily feed of wet mash is beneficial; good results, however, are obtained by the use of dry feeds alone, if the chicks are well supplied with green feed.

b—First day give milk to drink—preferably sour milk unless it is certain that sweet milk will be regularly available. The morning of the second day start feeding a grain mixture as follows:

Fine cracked corn ..... 7 pounds
Steel cut oats ..... 2 pounds
Cracked wheat ..... 1 pound

If the other grains are not available corn alone may be used, or to secure variety a good grade of commercial chick feed. Feed the grain five times daily, keeping the chicks a little hungry until the last feed at night, when they should have all they can eat. If infertile eggs are available they may be soft boiled and mixed with bran to a crumbly mixture, and fed once or twice a day in place of grain, preferably about noon, giving as much as they will clean up in fifteen minutes. As soon as they have learned to scratch for the grain, increase the depth of the litter in which it is fed. Feed green feed once daily. Keep fine grit and granulated bone always before them in hoppers. In the second week gradually reduce the number of grain feeds until they are getting only three a day; and substitute for the bran a mash as follows:

Bran ..... 3 pounds
Shorts or middlings ..... 2 pounds

Keep this before them in hoppers. Moist mash may be substituted for the noon grain feed if desired. If milk is not available add 12 per cent of meat scrap to the mash.

Ration No. 18—Washington Agricultural College Ration

SCRATCH MIXTURE:

Any standard chick feed, or the following home mixture:

Cracked corn, milo maize, or Egyptian corn ..... 4 pounds
Steel cut oats ..... 4 pounds
Cracked wheat ..... 1 pound
Cracked peas ..... 1 pound

Feed every two hours alternating with the grain feed:

Oat flakes ..... 1 pound
Boiled egg ..... ½ pound
Chick grit or sand ..... 4 tablespoons
Charcoal ..... 4 tablespoons

On the second day supply a bran mash in shallow pans as follows:

Wheat bran	8 pounds
Bone meal	4 pounds
Medium sand	4 pounds
Charcoal	1 pound

After eight or nine days discontinue the oatmeal mash and substitute the following:

Wheat bran	12 pounds
Shorts	3 pounds
Ground oats	6 pounds
Alfalfa meal	3 pounds
Soy bean meal	1 pound
Bone meal	2 pounds
Meat or fish meal	1 pound
Charcoal	3 pounds

Feed sprouted oats, fine cut clover, or lawn clippings.

Ration No. 19—California Experiment Station Ration

SCRATCH MIXTURE:

Wheat	20 pounds
Granulated oats	15 pounds
Millet	5 pounds
Rice	2 pounds
Cracked corn	6 pounds
Grit	10 pounds
Charcoal	5 pounds
Bone meal	5 pounds

The ingredients in this mixture are used at first very fine. After about ten days coarser wheat and oats are given, the amount being gradually increased until no small chick feed is used. Then whole wheat and coarser cracked corn are added and the amounts of these gradually increased until at six or seven weeks they are the only grains fed.

After the eighth to tenth day a mash is used, which is not always of the same composition, variations being made to suit the availability and cost of feeds. The two following are recommended as equally satisfactory:

a—Bran	3 pounds
Shorts	2 pounds
Coarse corn meal	1 pound
Oatmeal	1 pound
Meat meal	¼ pound
Bone meal	¼ pound
Charcoal	¼ pound
b—Bran	4 pounds
Alfalfa meal	2 pounds
Corn meal	1 pound
Meat meal	¼ pound
Bone meal	¼ pound
Charcoal	½ pound

These mashes are fed either dry or moist.

Ration No. 20—Kansas Experiment Station Ration

SCRATCH MIXTURE:

Corn chop (sifted)	2 pounds
Cracked kafir corn	2 pounds
Cracked wheat	2 pounds
Millet	1 pound

This is fed in litter five times a day for the first few days, after that three times a day. After a few weeks whole wheat and larger cracked corn are substituted for the small grains. The following dry mash is kept before the chicks all the time:

Corn meal	2 pounds
Shorts	2 pounds
Bran	2 pounds
Meat scrap	2 pounds
Charcoal	½ pound

These foregoing rations have been taken mostly from recent bulletins, though in a few cases where recent bulletins either do not give specifications as recommended for a state, or give one or more of the rations for other states as given above, the writer has gone to publications of eight or ten years back for rations as recommended especially for the locality. As a matter of fact, no important changes in chick feeding practice have occurred in the past decade—except changes in individual practice. The popularization of the use of dry mashes, which took place in the early years of this century made the only considerable change in methods of chick feeding that has taken place since the development of artificial hatchers and brooders made it possible to handle chicks in large numbers. All rations—probably—that have been used at experiment stations and colleges were first used by practical commercial poultrymen, but in general the statements of practical poultrymen of their methods of feeding are not specific as to amounts, while the educator or investigator ascertains either by measurements of ingredients in commercial poultry keepers' rations, or by experimenting with the ingredients he recommends in various proportions, the ordinary average composition of the ration he uses. The great value of formulas given by educational and experimental workers is that **they supply definite standards as bases for feeding.** A superficial comparison of the twenty rations here given, however, will show any person that no fine balancing of ingredients is necessary. If that were so we would not find dissimilar rations used in near-by states with the same climate and general conditions, and similar rations used in widely separated states with very different climatic conditions. Some states not represented here were omitted because the rations their experiment stations recommend are those that have been popularized by institutions in the above list. Men trained in an institution in one section and taking charge of work in an institution in a different section are apt to take with them the methods they learned, and if they are not themselves adaptable they may at first urge the methods they know best, though the practice of good local poultrymen would indicate certain modifications of it as desirable for that locality. The thing that most affects the acceptance of particular formulas for feeding in many localities remote from the institutions at which they have been worked out is the completeness of detail in the description of a feeding method. In other words, the better an educator does his peculiar part of giving the public instruction, the more widely his ideas will be accepted, regardless of the fact that many other formulas, not so well presented may be just as good, and some may be better for particular localities and conditions.

The reader will note that in some of the rations given above, gradual changes to suit the age of chicks, or to use more economical feeds are indicated, and that these changes obviously are not made in accordance with careful computations of the chemical values of the feeds used, but are such changes as a practical feeder would make on practical judgment of the commonly known properties of feeds. Also in using any formula, the quality of articles in it—as they can be obtained—must be considered, and if an article is of poor quality, the standard of the ration as a whole must be kept up by increasing the quantity of something of higher nutritive value. It is the intention always to avoid the use of inferior articles, especially for brooder chicks, yet there are times when a poultry keeper has to use them to a limited extent because of inability to get sufficient supplies of the desired quality.

In general a poultry keeper may be sure that a ration that gives satisfactory results at an agricultural college or experiment station in his section is a good ration for him to use. Comparison of the rations recommended by various institutions also should show him that if for any reason a ration recommended especially to poultry keepers of his state is not as available, or as economical as some other ration, he not only has a wide range of choice in rations recommended by other institutions, but the whole list of standard commercial mixtures is used successfully in nearly every part of the country, their distribution being governed not by their peculiar adaptability to certain localities, but by costs of transportation.

Some Chick Rations Used and Recommended by Practical Poultry Growers

Ration No. 21—Henry D. Smith's Ration

Feed five or six times a day any good commercial chick feed, alternated with feeds of dry mash or beef scrap. For dry mash use a mixture of bran shorts and corn meal, equal parts by measure. Feed beef scrap separately in troughs once or twice a day, giving the chicks what they will clean up in a few minutes. After the chicks are three or four weeks old the chick feed is largely discontinued, and with the dry mash and scraps still given as described, they are fed a scratch mixture consisting of two parts cracked corn, one part cracked wheat, and one part hulled oats. Water is kept before them all the time in small pans, fed by automatic faucets. For green feed, cut clover is used.

Ration No. 22—H. J. Blanchard's Ration

First few days feed granulated oatmeal four times a day, and give water—not too cold. Then begin gradually working them on a diet of cake alternated with cracked wheat. The cake is made of ground oats (hulls sifted out), corn meal and bran, about equal parts by measure, with a little high-grade beef scraps mixed in while dry. The mixture is moistened with milk, salted as for the table, leavened with soda, and baked. As the chicks grow older the amount of beef scrap is gradually increased. Just as soon as we can get fresh grass or clover it is fed daily, cut in one-eighth inch lengths. Chard, lettuce, and beet tops are also used.

Ration No. 23—James Rankin's Ration

Start with bread crumbs and hard boiled egg chopped fine, one part of egg to five parts of bread, with plenty of fine grit mixed in. After three days give equal quantities of wheat bran and corn meal with a little fine beef scraps, and one feed each day of rolled oats and cracked corn. As they grow older give clabbered milk, boiled potatoes and green grass daily.

Mr. Rankin, who was one of the most skillful poultrymen in America, once grew four hundred Brahmas to four or five months age, in a yard only six rods square, using this ration the greater part of the time, but toward the last feeding whole corn and giving finely cut corn fodder for green feed.

Ration No. 24—W. D. Rudd's Ration

First two weeks—crumbled johnnycake and granulated oats, dry; with green feed and powdered charcoal always before them. After two weeks give also whole or broken wheat and cracked corn. At three weeks begin to give moist feed, stale bread soaked in sweet milk, thickened with corn meal—meal about one-half of the whole. At four weeks discontinue granulated oats, and keep cracked corn always before the chicks.

Ration No. 25—J. A. DeMar's Ration

First feed Spratt's chick meal, alternated with rolled oats, cut oatmeal and fine cracked corn, with sweet milk in one fountain and water in another. Feed in this way about three weeks, then put them on a mash made of two parts corn meal, and one part shorts, with a little beef scrap and some grit. This is fed once a day, just what they will eat up clean. They are fed the first two weeks about five times a day, after that three or four times. After the chicks are three weeks old cracked corn, wheat and barley are substituted for the oatmeal and Spratt's feed. From the time the chicks are a week old they are fed cabbage and mangels.

Ration No. 26—P. R. Park's First Dry Feed Ration

Two bags of corn to one bag of the best wheat, well mixed and ground to about the size of a pinhead, and fed dry in a dish or hopper, also a dish of the best beef scrap, kept constantly before the chicks from the time they are hatched. These, with water or milk to drink—milk preferred, form the entire diet on range which provides only limited green feed.

This ration is of special interest because its use marked the beginning of the dry feeding movement. It was first used by Mr. Park in 1897, and first published by him in a symposium on feeding in Farm-Poultry, April, 1901.

The six rations last given are typical of good practice among poultry keepers who worked out rations by trying them out, and worked with rough measurements, and varied rations from time to time according to their judgment, before educational methods demanded more exact specifications for feeding. Ration No. 24, taken from a circular of 1897, was probably used as there given from about 1872.

Observations on Some Features of Common Chick Rations.

The reader studying the rations that have been given will note here and there insistence by some authorities upon points which others regard as immaterial, and also that there are some recommendations of the author of this book with which various authorities appear to disagree. A case in point is the use of hard-boiled eggs. Probably three-fourths of the instructions for feeding young chickens strongly advise the use of hard-boiled eggs. Every one knows that in cooking eggs for the table one egg may be boiled hard yet be tender and easily digestible, and another boiled in a different manner may be tough and indigestible. There is no doubt that eggs can be hard-boiled so that they will be all right for young chickens; there is equally no doubt that the greater part of the eggs cooked as first feeds for young chickens, being stale to begin with, and boiled with no attention to any point but thoroughness of boiling, are quite unsuitable for this purpose. The writer early in his commercial poultry keeping experience quit hard-boiling eggs for chicks because he preferred to use them in johnnycake, and if he had any not used in that way, it was much easier to make raw mashes with them. He had no particular trouble attributable to hard-boiled eggs. But after he engaged in journalism, and was often called upon to advise poultry keepers who were having trouble with their young chickens, he found that the feeding of hard-boiled eggs was one of the most common causes of indigestion in young chickens, and was not generally suspected as the cause, for the simple reason that nearly all authorities classed it as one of the best feeds, and it was often fed without any bad results.

Whenever there is trouble with chicks that are given hard-boiled eggs freely, and no other plain cause for it can be found, it is reasonably safe to advise the poultry keeper that if the hard-boiled egg is cut out the trouble will promptly disappear.

Another case in point is the use of meat meals and meat scraps, bone meal, and charcoal in liberal proportions in mash mixtures, especially in moist mashes. Many of the formulas recommended contain more of these things than chicks with normal appetites are likely to relish as continuous diet. In dry feeding this may not do much harm, or may do no harm, because the chicks can pick the mash over and to some extent select their diet. They can reject an excess of charcoal, and fine bone meal, being heavier than other ingredients, works to the bottom of the pan or hopper and much of it is eventually thrown away. Much more meat can be eaten without bad results in a dry mash than in a moist one. But even a dry mash may be rendered unpalatable by an excess of bone and charcoal, or dangerous by an excess of highly concentrated animal feed, and in the latter case the normal appetite leads the chick to stop eating the mash when the taste of meat in it is no longer agreeable, with the result that it takes much less of the other things in the mash than it was intended to take. So whenever in feeding one of these dry mashes with heavy proportions of meat, bone meal and charcoal, the chicks seem not to relish the mash, the best thing to do is to cut out the bone and charcoal entirely for a few days, and greatly reduce the meat scrap. Then experiment a little with smaller proportions of the bone meal and charcoal to determine what the chicks want, or—better still—simply provide these accessories in separate receptacles so that the chicks can eat them at will.

The reader examining the rations given will also note conflicting instructions and opinions in regard to the use of milk in different forms. It is apparent that some poultry keepers feed milk in any form without any bad effects, and that others get better results from sour milk than from sweet, and that some can use either regularly, but cannot change abruptly from one to the other. These differences are due either to other things in the ration or to the fact that milk in a particular form does not agree with certain stock, or perhaps to a tendency to indigestion accompanying some weakness originating in wrong temperature, or in the effect of contaminated land. No one can say with certainty on a statement of the ration, what other cause may affect results of feeding it, but most practical poultry keepers of wide experience know that thoroughly rugged and hearty chicks are not upset by little things of this kind and that there is always, in such cases, some condition which should be remedied for the general good of the flock.

How Much to Feed Chicks

Instructions for feeding chicks generally advise the

novice to regulate the amount given by the appetites of the chicks. This seems to the novice quite unsatisfactory. He would like definite statements of quantities to feed a given number of chicks. It should be definitely understood that chicks cannot be fed by the scales; but, understanding that, knowledge of what a particular lot of chicks required, or of average requirements of a given number of chicks will enable a beginner to judge whether his chicks are eating about a normal ration. The Washington Experiment Station has worked this out for 100 average chicks fed the ration numbered 18 on page 55. The following statement is an abstract from their report.

Second Day—First Feed:
11:30 A. M.—1 oz. oatmeal mixture.
2:30 P. M.—1 oz. oatmeal mixture.
4:00 P. M.—1½ oz. oatmeal mixture.
At dusk—1½ oz. oatmeal mixture.

Third Day:
Daylight—1 oz. oatmeal mixture.
10:00 A. M.—1 oz. oatmeal mixture.
12:00 Noon—1 oz. oatmeal mixture.
2:00 P. M.—1½ oz. oatmeal mixture.
4:00 P. M.—1½ oz. oatmeal mixture.
Dusk—2 oz. chick feed.

Fourth Day:
8:00 A. M.—2 oz. oatmeal mixture.
10:00 A. M.—2 oz. chick feed.
12:00 Noon—2 oz. oatmeal mixture.
2:00 P. M.—2 oz. chick feed.
4:00 P. M.—2 oz. oatmeal mixture.
Dusk—3 oz. chick feed.
Night—2 oz. chick feed for first feed next morning.

Fifth Day:
8:00 A. M.—2 oz. oatmeal mixture.
10:00 A. M.—3 oz. chick feed.
12:00 Noon—3 oz. oatmeal mixture.
2:00 P. M.—3 oz. chick feed.
4:00 P. M.—2 oz. oatmeal mixture.
Dusk—Observe crops of chicks and give chick feed if needed.
Night—2 oz. chick feed.

Sixth Day:
8:00 A. M.—3 oz. oatmeal mixture.
10:00 A. M.—3 oz. chick feed.
12:00 Noon—3 oz. oatmeal mixture.
2:00 P. M.—3 oz. chick feed.
4:00 P. M.—4 oz. oatmeal mixture.
Dusk—4 oz. chick feed—more if needed for fairly full crops.
Night—4 oz. chick feed.

Seventh and Eighth Days:
8:00 A. M.—3 oz. chick feed.
10:00 A. M.—4 oz. oatmeal mixture.
12:00 Noon—4 oz. mash.
2:00 P. M.—4 oz. chick feed.
4:00 P. M.—4 oz. mash.
Dusk—5 oz. chick feed.

Ninth Day:
8:00 A. M.—4 oz. chick feed.
10:00 A. M.—4 oz. chick feed.
12:00 Noon—5 oz. mash.
2:00 P. M.—5 oz. chick feed.
4:00 P. M.—6 oz. chick feed.
Night—4 oz. chick feed.

It should be noted that in addition to these definite amounts given at definite times the chicks have a bran mash always accessible, hence the amount they eat is probably always a little in excess of the above quantities.

The amount of feed consumed at first is so small that inexperienced feeders are apt to make the mistake of increasing the amount given too slowly, leaving the chicks somewhat underfed. For this reason as well as to insure that chicks can always have something when hungry it is good policy, no matter whether a particular ration that may have been selected calls for it or not, to keep a light dry mash always before the chicks. If this is consumed quickly, and the chicks seem quite hungry for it, the quantity given at each regular feed should be increased until the chicks will only take an occasional nibble at the permanent dry mash.

Relation of Ration to Purpose in Feeding

Up to weaning age the same ration will serve for all chicks regardless of the particular use to which they are to be put. There is no perceptible advantage in making adjustments of rations with a view to the special object for which the chicks are grown, because the practical way to handle chicks is to give all the ration suited for normal development up to this age, and in the next stage separate them according to quality and apparent capacity for development and then apply the rations and treatment suited to different purposes. This will be taken up in detail in the next chapter. The period considered in this chapter, from hatching to weaning, should be considered a general preparatory period in which each individual chick shows its capacity to respond to and profit by good feeding and management.

It is commonly said that the first three weeks are the most critical period in the life of a chick, and that chicks that survive after the third week can usually be raised. While it is true that losses are ordinarily most numerous in the first two or three weeks, it is a mistake to suppose that the necessity for careful management is diminished after the chicks reach that age. Relaxation of care in the latter half of the brooding period probably stunts as many chickens, that up to that time were normal, as are lost outright in the first few weeks. Many poultry keepers discontinue heat in brooders too soon, thinking it economy to save coal even at the risk of chilling the chicks. It is always wiser to have heat that the chicks can get to if they feel the need of it, than to take chances of their becoming chilled. Until settled warm weather comes, chicks need some heat until well covered with feathers. Failure to supply it has much to do with apparent inefficiency of rations. Also after the chick is eating coarse feed freely it should still have more meals than old birds get. The poultry keeper who wants to grow really good chicks should make it a point to feed them all they will eat, and to reduce the number of feedings only as the chicks become indifferent to the extra feeds.

CHAPTER VI

Feeding Chicks From Weaning to Maturity

Relation of Conditions to Development For Different Purposes—Model Rations For Growing Chickens—Cultivation of Good Habits in Feeding—Use of Green Feeds and Milk in Hot Weather—Average Normal Weights of Various Breeds at Different Ages—Amount and Cost of Feed Required to Produce a Pound of Poultry Meat

WHEN chicks have been reared to weaning age with hens, each hen having from ten or twelve to perhaps eighteen or twenty chicks, it is usual to combine broods when the hens are taken away, and to put the chicks in lots of a few dozen in roosting coops three or four feet wide by six to eight feet long,—coops that can be easily moved about by two men. When the chicks are started in small brooders the same course may be followed, but a brooder lot of chicks will perhaps be enough for a single roosting coop, or the chicks from a brooder of medium capacity,—divided according to sex—may make two lots for two roosting coops. Nearly always when hens or small brooders are used, operations are on a scale or a system that uses roosting coops of relatively mall size and capacity for the growing chicks.

When chicks are brooded in lots of two or three hundred and upward, they usually are divided at this age into much smaller flocks, especially if there is land available to give them good range, and it is desired to make the best possible use of this advantage. It must be kept in mind that the nature of chickens is to range only within a comparatively short radius from their coops, and that while hunger will naturally make them forage a little farther when in such large flocks that the feed on the range they would normally use is soon exhausted, they will not as a rule go enough farther to make it practical to get the same benefit from range for flocks of a hundred or more with the houses at long distances that would be obtained for flocks of from fifty to seventy-five or eighty at much shorter distances.

Practically the only poultry growers who give large stocks of chickens range enough to get all the advantages of range are the large breeders of exhibition poultry. Not all of these fully realize that purpose, but all get a great deal of the advantage of range, and many get all of it. Those who can give less range than they wish are invariably careful to feed so as to make up what the range lacks, and some with the best of range conditions make doubly sure that the growing chicks will lack nothing, by giving them additional vegetable and animal feed. Most small breeders of choice exhibition stock give their growing chicks good range, limiting the numbers reared as necessary in order to do so, but there are still many who grow some exhibition stock of good quality in limited quarters and on land that produces no vegetation to speak of for them. The greatest difficulty in growing chickens for exhibition purposes under such conditions is to secure intensity of color in sections that tend to be weak, and a luster and finish in the plumage that make much of the difference between the top-notcher and the second-rate specimen

In all dark-colored birds grown under intensive conditions, it is difficult to get wing flights free from white, or to prevent white from appearing in small amounts where it is not wanted. Even in birds that have a great deal of white in the plumage, as the "ermine" type of color of the Light Brahmas and other varieties with the same markings, birds that are not grown on good range or liberally supplied with everything needed for their highest development will be likely to show much more white than is desirable in black sections and the black in them generally will be dull and lusterless. White varieties are better suited than any others for growing under such conditions, yet the breeder who fancies a variety especially subject to the development of plumage faults when grown under conditions that make such faults hard to avoid, will usually find that, by avoiding overcrowding and giving his stock the best of attention, he produces birds fully equal to those grown by the majority of small breeders who have fairly good range and other favorable conditions for their growing chicks, and—relying upon these—are careless about providing at all times the things necessary for the best development of their chicks.

While it is always gratifying to a poultry keeper to produce stock of the highest possible excellence, failure fully to reach the best development is not an unbearable hardship to those who enjoy producing fine birds, and must indulge this taste under conditions that are more or less adverse to it; nor is it in any way particularly disadvantageous except to those who exhibit in the strongest competition and breed to sell to the most critical buyers. Most of the stock to be used for ordinary breeding purposes, whether for standard stock, for eggs, or for the table at maturity, can be grown in good quality

COOPS FOR GROWING CHICKS ON RECENTLY CLEARED LAND AT THE GOVERNMENT POULTRY FARM, BELTSVILLE, MD.

on a range that affords exercise, and the sun and shade as desirable, though it affords little feed. Even with the lack of feed from the land, freedom to move about, the absence of restrictions, the opportunity to seek out the most comfortable places at different times, and the better sanitary condition of the land make for the growth of much better stock on poor range than in small yards.

In growing chickens for breeding purposes the aim should always be to get approximately standard size and weight at the age at which the breed should mature. In growing chickens for market or for egg production only, it does not, as a rule, make so much difference about getting full development, and it may be fore profitable, through the economy in labor and equipment, to use methods by which a greater number of birds are grown to the development that suits their use as layers or for the table at less cost than when they are handled to secure the best individual development. In general, to secure the highest individual development it is necessary to keep chickens in quite small flocks. One of the principal reasons why so few who try them are able to grow Asiatic fowls to full standard size is that to do this at all uniformly they must be kept in small flocks, not more than twenty-five or thirty together. When they are grown on a large scale for market and kept in flocks of from fifty to a hundred or more under the conditions, as to range, which usually exist on somewhat intensive commercial poultry plants, they do not make full development, but they make as large chickens as the market requires, and they are grown more economically, —that is, more pounds of meat are produced at less cost, than when grown to get the best individual development possible.

Similarly, in growing pullets for egg production only, pullets that are from standard-weight stock and are themselves a pound or so under weight, may lay as many eggs and as large eggs as their sisters of full weight or over. And a hundred of the pullets slightly undersize might be grown in the same quarters and with no more attention than would be required to bring from half to two-thirds of that number to full development. That means that 1000 pullets for laying only can be grown from weaning age at the same cost for everything but feed, as about 600 pullets for breeding purposes.

So when the chickens are weaned it is policy, especially for those who are limited as to land, room, and equipment, to separate them according to the purpose for which they are to be used. Those that are to produce future generations should be given the care that will make for the best individual development, and the others,—according to the use to which they are to be put—should have conditions, care, and feed that will make them most profitable. This assortment of chicks ought to be made wherever the number grown is large enough to use more than one roosting coop for chicks weaned at about the same time. Many poultry keepers with comparatively small flocks neglect to do it, thinking that it is just as well to let all grow together and separate at maturity those that are desirable as breeders. The objection to this practice, where chicks are at all crowded or restricted for range, is that the most promising chicks for breeders are not given the best chance to develop, but are only allowed to show the best they can do under conditions less favorable than could have been provided for them with a little effort on the part of the keeper.

While, as has been said, good work with chicks often gives good chickens under rather unfavorable conditions, the poultry keeper ought not to take the chances of that any farther than is necessary or plainly profitable—as when birds that are not the best in actual quality are yet good enough for a particular purpose. And above all he should make every effort to give birds he wishes to breed from, the best conditions that his circumstances permit. Failure to do this hastens the deterioration of stock which commonly takes place whenever the methods or the conditions are against full development of individual specimens. At best it is hard to grow breeding stock year after year without good range, and continue to keep up the size and stamina. The first generation of chicks grown in confinement from stock that was previously range grown, is often as good or better than the parent stock. With good feeding in confinement, and plenty of room in the house, the birds so raised may be larger than their parents, and the hens probably will be as good or better layers.

NEAR VIEW OF ONE OF THE COOPS IN SCENE ON THE OPPOSITE PAGE

But when this stock is bred from, it will nearly always appear that it lacks something of the vitality of its ancestors, and if it is bred year after year without bringing in the blood of stock grown under more natural and favorable conditions it soon becomes greatly deteriorated. Because this deterioration is not much in evidence until the second generation grown under conditions not favorable to full individual development, many novices growing stock under such conditions are misled. They suppose that the fact that they grew the stock apparently as

well as it could possibly be grown under certain conditions one year is positive proof that the conditions are in no way unfavorable, and believing that the conditions are all right, and that the stock—as shown by its development in the first season—is all right, they take it for granted that if the chickens do not thrive, and fall far short of the expected development, the trouble must be with the feed. If they have been mixing the feeds themselves they suppose that one or more ingredients are of inferior quality, and perhaps detrimental. Usually they blame the meat scrap. If they have been buying a prepared feed they become positive that the manufacturer is putting out an inferior article. They begin to try other feeds in a search for one that will do the impossible. Naturally they do not find one.

Thousands of poultry keepers are never able to establish a satisfactory stock because they do not take the trouble to pick out the best of their chicks at weaning age and either give them conditions under which they will make their best possible development on the same ration that the rest of the chicks get, or give them the special care and feeding that will give the best development under the conditions under which all chicks are kept. It cannot be expected that the stock birds, as they are grown on plants which have to grow them under somewhat intensive conditions, can be kept to a development and vitality that is so good that there is no occasion for frequent introductions of stock grown under more favorable conditions; but, by growing as many birds as he needs for breeding purposes under the best conditions he can give them, a poultry keeper who is limited for room keeps his breeding stock where a little new blood occasionally will prevent any marked deterioration.

We have then to consider the following classifications of chickens at weaning time in their relation to subsequent feeding practice:—

A—Chickens that are to be used for exhibition or for sale in exhibition quality, and which must be as free from every fault, and as superior in every quality as it is possible to make them.

B—Chickens that are to be used for minor exhibitions or breeding ordinary standard specimens, and which must be well developed and vigorous, but not necessarily free from the superficial faults which may result from failure to apply the highest skill in feeding or to supply the environment most favorable to development.

C—Chickens that are to be grown for layers, and which may without prejudice to their value for that purpose be somewhat below the standard size and weight for their breed.

D—Chickens that are to be used for the table, either as broilers, fryers, or roasters, and in the growing of which the development of constitution and stamina need not be considered at all, farther than that they must have constitution and digestive power enough to keep them growing well with heavy feeding for the period required in any particular case.

E—Chickens that at weaning age are plainly not profitable feeders for any of the above purposes.

It is not necessary in practice to make all these divisions at this stage. Class A may be considered as a special class which ordinarily would not be divided except perhaps by sex, for being from stock carefully selected for quality for many generations only a small percentage—the marked culls—will be birds that ought not to have the best possible conditions of growth. These the wise breeder simply shuts in a small pen and kills for the table at squab broiler size.

In the ordinary conditions where upwards of a few hundred chicks are grown, chickens as classified above in B and C, and also those as of Class D which are intended for large roasters may be carried along together for a while if it is more convenient. This may be the case where chickens are to range on grass land after a first crop of hay is cut, or in corn after it is well started, or on any piece of land not available for them at the time they are weaned. The capacity of any house or coop for them at this age is of course much greater than when they are a month to six weeks older—to say nothing of when they approach maturity. Hence, if provision is made for the removal of a part of the stock to other quarters before the coops become overcrowded, there is no objection to carrying chicks for stock birds, for layers, and for roasters all together as long as is convenient.

The feeding can be the same for all. The risk in it is that if hot weather comes sooner than expected, or if anything delays the division of the flock before it begins actually to crowd the capacity of the coop, overheating and crowding for even a single night may make quite a severe check on the growth of the entire number. It is always best, when it can be done, to put chicks at weaning age into colony coops in the numbers that the coops will accommodate until full grown. Then if the coops are of suitable construction and properly ventilated, there is no occasion to worry about possible overcrowding. At the same time, with due care to provide for such emergencies if they arise, and to make the division anyway comparatively early in this period, a poultry keeper can often save a good deal of work with his chicks and handle some other work on his plant to better advantage, by using the full capacity of his most convenient coops and range for chicks for a month or more after they go into the colony roosting coops.

Chickens that are to be used for broilers or fryers can be kept in coops with small yards or in open sheds. Some may be ready for small broilers, and any should be able to make broiler weights with heavy feeding before it affects their digestive organs. They need no more exercise than a little scratching for grain in litter to keep them contented. Those that are to be kept longest, as for fryers, can either be given a little more room and range, or fed more liberally with green feed until the time comes to finish them off.

Rations For Chickens From Weaning to Maturity

The following rations are principally rations corresponding to and following those given for younger chickens in the preceding chapter. Fully to identify each it is not only given the same title, but the same number—with the addition of the letter A.

Ration No. 1a—Model Variety Ration Recommended By the United States Department of Agriculture

SCRATCH MIXTURE

Two parts, by weight, of cracked corn and one of wheat; or, equal parts cracked corn, wheat, and oats. This may be fed at intervals by hand, or if the chicks have good range it may be kept before them in a hopper.

DRY MASH

Bran	2 pounds
Middlings	2 pounds
Corn meal	1 pound
Red dog, or low grade flour	1 pound
Meat scrap	½ pound

This should be kept before the chicks in hoppers. If preferred the meat scrap may be left out of the mash and

given in a separate hopper. Where milk is available the chickens should have all they will drink. Keep charcoal, grit, and shell before the chicks at all times, and when they are confined to small yards, or have limited range, feed liberally of green feed.

Ration No. 2a—Ontario Agricultural College Ration

Chicks are taken from the brooders at from six to eight weeks according to the weather. From about eight weeks they are fed usually three times a day, a mash as previously given in the morning, and whole wheat and cracked corn at noon and night. If it is desired to force growth, two feeds of mash are given daily, and the amount of animal meal in the mash is increased.

Ration No. 3a—Cornell Ration for Chicks

Feed in hoppers the mash mixture No. 3 given for small chicks, and equal parts of wheat and cracked corn. If it is desired to hasten development, give one meal a day of moist mash. Provide grit, charcoal, shell, and bone. Give grass range or plenty of green feed.

Ration No. 4a—New Jersey Experiment Station Ration

Keep the dry mash before the chicks all the time, and twice a day scatter over their range a grain feed of equal parts of whole wheat and cracked corn.

Ration No. 5a—Ohio Agricultural College Ration

Omit the noon feed of grain previously given, and put in a hopper of the mash mixture. Keep this open for an hour at noon. After the tenth week omit the morning feed of grain and keep the hopper open until noon. From this time give chicks only one feed of grain a day—late in the afternoon.

Ration No. 6a—Massachusetts Agricultural College Ration

Keep the dry mash always before the chicks in hoppers, and feed night and morning what wheat and cracked corn the birds will eat readily. Do not feed so much that they will not forage.

Ration No. 7a—Maine Experiment Station Ration

Keep the dry mash before the chicks in hoppers, and feed in litter, twice a day, equal parts of good cracked corn and whole wheat.

Or, keep in separate slatted troughs cracked corn, wheat, meat scrap, cracked bone, oyster shell, and grit, and let the chicks eat at will.

Ration No. 8a—Wisconsin Experiment Station Ration

Give to chicks on range, in hoppers, a mash of two parts each of bran and corn meal, and one part of middlings. For grain feed cracked corn, or when barley is low enough in price feed some of it. Feed grain either broadcast or in hoppers, according to circumstances. Where sparrows are numerous there is less loss by feeding in hoppers.

Ration No. 9a—Minnesota Experiment Station Ration

Put chicks on free range and feed from hoppers large enough to hold a week's supply, a hopper of cracked corn and small grains, and one of the dry mash for each colony of chicks.

Ration No. 10a—Purdue Experiment Station Ration

Put the chicks on grass range and feed in outdoor hoppers large enough to contain two or three weeks' supply; one hopper of mash, and one of whole wheat and cracked corn to each house.

Ration No. 11a—Oklahoma Experiment Station Ration

With the dry mash supplied in hoppers give twice a day equal parts of wheat, cracked corn, and kafir corn; or, two parts cracked corn, two parts wheat, one part oats.

Ration No. 12a—Missouri University Ration

The same as followed from the time the chicks are three or four weeks old.

Ration No. 13a—Manitoba Agricultural College Ration

After the chicks are six wecks old put their dry mash and grain in a two compartment outdoor hopper, and give them free range.

Ration No. 14a—Michigan Experiment Station Ration

Continue the dry mash in hoppers, and feed wheat and cracked corn, either in hoppers or scattered on the range.

Ration No. 15a—North Carolina Experiment Station Ration

Feed chicks on range the same as old stock—mash of wheat bran, corn meal, and ground oats; grain feed, cracked corn, wheat, and oats.

Ration No. 16a—Montana Experiment Station Ration

With the dry mash used for chicks when younger feed a grain mixture of equal parts of wheat, oats, and cracked peas, by measure.

Ration No. 17a—Oregon Agricultural College Ration

Continue the ration given for small chicks in the latter part of the brooding period.

Ration No. 18a—Washington Agricultural College Ration

Feed the grain mixture with coarser grains substituted for the fine, three times a day. Keep dry mash in hoppers. Give unstinted supply of succulent green feed.

Ration No. 19a—California Experiment Station Ration

Same as during latter part of brooding period.

Ration No. 20a—Kansas Experiment Station Ration

Same as during the latter part of the brooding period.

Ration No. 21a—Henry D. Smith's Ration

Cracked corn and meat scrap in separate hoppers, cabbage, mangels, or green rye. It should be said that this ration was used for winter chickens, that is chickens hatched in the late summer and early fall, and making their growth from weaning to maturity in winter, not in summer.

Ration No. 22a to 26a

Same as during the latter part of the brooding period.

COOPS FOR GROWING CHICKS AT EDGE OF APPLE ORCHARD ON A NEW ENGLAND FARM

It will be noted that there is even more apparent similarity in rations as used and recommended by different institutions and practical experts for chicks during this period, than during the earlier brooding period. There is, in fact, a sameness and a simplicity of statement that tends to be misleading, giving the impression that the chickens may be left much to themselves after they have passed the weaning age. It is true that when the matter of keeping them warm no longer requires special attention, the routine work of caring for them is much reduced, and that the task is still further lightened when circumstances admit of hopper feeding of both the mash and the grain. Yet it is rarely practical to put feeding wholly on a system that is entirely automatic,—feeding the grain products in bulk, letting the chicks eat of them at will, and leaving them to get all the feed accessories from the range. That can be done only where the range is unusually good, where the temperature is constantly moderate, where there are no enemies of any kind to molest the chicks, and where the utilization of waste feeds not on the range used by the chicks does not have to be considered.

Usually one or more of the considerations mentioned make it necessary to modify more or less the plan of hopper feeding, and notwithstanding the advantages of that practice, and the economy of using it, the fact remains that a certain amount of personal attention to feeding, and the existence in a flock of poultry of a sense of dependence upon and confidence in the person who feeds them, make for better results than when the rela-

tion between the feeder and the fed is one that the latter do not recognize. A poultry keeper has to keep close watch over all his stock to KNOW whether things are going right or not, and that being the case, it is no hardship, and is in various ways an advantage, to supplement the hopper feeding with some light regular feeds, and also with occasional special feeds as conditions may make that advisable. The two points in feeding that call for special attention in summer are assurance of supplies of green feed and animal feed, and special feeding to maintain growth as well as possible in extreme hot weather.

Whatever the object in growing chickens, the best results are secured only when they grow steadily from start to finish. In the cool weather of winter and spring we have to keep young chickens warm that their vital processes may proceed regularly and as economically of feed as possible. In the warm weather of spring, and the moderate weather of summer, the temperature conditions are most favorable to rapid and continuous growth. With an average atmospheric temperature of sixty to seventy, and the heat-producing elements in the feed called upon to keep the body temperature of the bird about thirty-five to forty-five degrees higher, and the same elements also providing the energy for an active life, the bird can utilize a lot of carbonaceous material. But when the atmospheric temperature goes to ninety, or a hundred or more, and remains there for days at a time, the carbonaceous material in the ordinary daily ration is far in excess of the needs of the system, and if the bird eats the usual amount it overheats the body.

If growing chickens are left to themselves to eat what they choose of the grain and mash before them, and to supplement this with such green feed as their range affords, they usually—unless the range affords an extraordinary amount of highly palatable green feed—either injure themselves by overeating of the heavy grain ration, or by declining to eat much of it, consume so little feed that they may stop growing, and even lose weight. Hearty chickens are apt to overeat until the excess of heating feed makes them uncomfortable and they lose appetite, and perhaps develop mild symptoms of digestive trouble. Chicks that are daintier feeders are more likely to cut

BREAKFAST AT DAWN ON A GRASSY RANGE

their ration to what green feed and insects and worms they can get without much effort in the coolest parts of the day, with an occasional nibble at the grain and mash accessible as they forage.

It is at such times that the value of milk and the advantage of liberal supplies of succulent green feed that the chicks will eat freely are most fully demonstrated. In continued extreme hot spells we cannot by any system of feeding keep up the growth that is obtained under normal temperate weather conditions on a normal consumption of ordinary concentrated rations. But for short periods of extreme heat we can feed so that there is no perceptible check of growth, and for longer periods we can—by the same methods—keep up a constant growth at less than the normal rate, and at the same time keep the birds in such good appetite and physical condition, that as soon as relief from the extreme temperature comes they eat full rations—not requiring several days, or a week or more to recover from the effects of the hot weather.

Where chicks on range are fed in hoppers, they should get out with the beginning of daylight, even though it may have been customary for the attendant—for his own convenience—and their safety—to keep them shut in the coop until a later hour. That is not really good poultry practice at any time, though in normal weather when the chicks are eating heartily it may not make such a great deal of difference if they don't get out as early as they would like to in the morning. But in extreme hot weather they should be out at daylight, and if the danger from their enemies that prowl at that time is such that they should be watched, someone should watch them as long as necessary.

If the range is good, the chicks released in the earliest morning probably will pay little attention to the feed in the hoppers, but will begin at once to forage for the worms which are likely to be at the surface of the ground, and for whatever green feed takes their fancy. They will keep busy in this way until the sun becomes uncomfortably warm, or until with crops fairly well filled with light feed they feel like filling up with grain. If the grain is usually fed by hand it is a good plan, when the chicks are let out, to scatter a feed of it about—a lighter feed than usual. The amount they will eat before and after foraging will depend on circumstances. An expert feeder can tell by the way they go at it about how much to throw out and have it eaten quite early in the morning. It is a good plan to broadcast this feed over the range; then the chickens eat a little grain with the other things as they go.

About nine o'clock give the chickens all they will eat up clean of a light mash,—that is a mash containing little corn meal or concentrated feed. After eating this they will usually prefer to keep quiet in the shade until the heat of the day has passed. About noon they will relish something quite light and cooling, as clabber milk, lettuce, rape, or cabbage, and—in the latter part of the season—waste tomatoes, cucumbers, fruit and melons of all kinds. If it is desired, the sour milk may be thickened with bran and midlings, or soft fruits and vegetables may be used the same way. When fresh lettuce or rape is given care should be taken to put it in the shade, not only because the chickens are reluctant to go into the hot sun, but because if these things are not eaten up at once they will wilt badly in the heat and then the chickens will not eat them at all, and they are wasted. If the chickens are indifferent to green feed offered them at noon it is as well to feed it early in the morning or later in the evening. Often they will eat it greedily when the heat of the day has passed and they begin to feel hungry and like moving about.

As the sun declines and the heat is less intense, the chickens will begin to feed and forage, and are likely to stay out much longer than when they feed freely at all hours of the day. They should be allowed to stay out as late as they like, and if they do not seem to care for their ordinary rations, light mashes should be offered them, and they should have all the milk, either separate or

thickened with bran, that they will eat. They may not eat as much in all as they ordinarily do, but they do not need quite as much, and if they eat fairly well of light feeds and take about half the usual amount of grain in one way or another, they will keep growing.

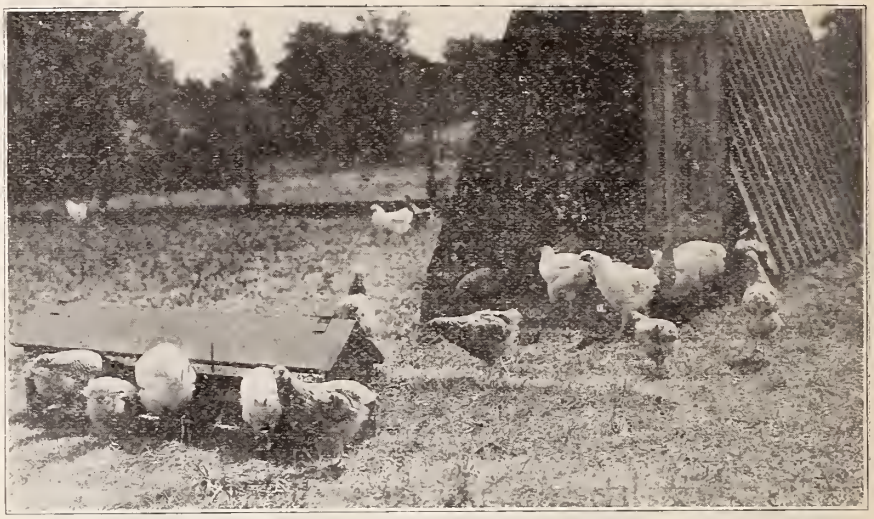
The question of providing a plentiful supply of succulent feed, not only for hot spells but for possible periods of drouth, is one that the wise poultry keeper considers at planting time in the spring. It rarely is safe to rely entirely upon the green feed on a range to supply the needs of a large stock of chicks for this class of feeds. The modification of rations for hot spells ought also to be a matter of forethought with the poultry keeper, and especially so when his ration generally carries a minimum of the feeds most necessary in hot weather. Chickens that always have plenty of milk and green feed before them will balance their own rations, but comparatively few chickens except moderate-sized flocks on general farms are so supplied. Most growing chickens elsewhere get only enough of green feed or of milk, or of both together to keep them in fair condition with a heavy grain ration in temperate weather.

A large proportion of flocks of growing chickens are in places where, both in their coops or houses, and in the yard or on the ground near and around it, the air simply stagnates in a hot spell. The circulation of air is none too good in ordinary still weather, but when the atmosphere generally is almost motionless and very warm there is no circulation in these places at all. Coops and houses should be designed to afford the best possible ventilation in extreme hot weather, even though there may not be occasion to use it fully except at long intervals. With this provision to make the chickens as comfortable as possible when the weather is hot, the poultry keeper ought to keep an eye constantly on the weather and try to anticipate weather changes which make modifications of rations expedient. On the occasional hot days in spring and early summer he should feed light and give as much vegetables and milk as possible at the hottest parts of the day. He should learn to know what the chickens relish best under different conditions, and to judge at once by the appetite they show whether a feed offered them is one that they want and will eat freely, and to judge also how far a manifest lack of inclination to eat at a regular time is due to want of relish for what is offered, and how far it may reasonably be attributed to lack of appetite for any feed—as a result of continuous hearty feeding.

It is this habit of observation—the cultivation of sound judgment as to the attitudes of poultry toward feed under different conditions and the development of skill in catering to the appetites of the birds, at the same time keeping them keen for their meals and ready to take square meals of almost anything in the feed line that is at all appropriate to conditions at the time of giving it, that make the skillful, practical feeder. That part of his craft cannot be learned from books, or from the instruction of others, but comes only with careful, interested observation and experience in discovering and correcting his mistakes in feeding.

How Stock Becomes Adapted to Certain Rations and Conditions

In judging the effects of any particular feed or system of feeding upon any lot of chicks, it is important to take into consideration the constitutional attitude of the flock or of different members of it toward that feed or system of feeding. In the statements about rations given out by various authorities, the importance of making gradual changes in rations often is emphasized. Poultry often refuse to eat much of a feed to which they have not been accustomed, and often those that eat freely of a new feed immediately develop some form of trouble in the digestive tract. But individual birds differ greatly in this respect, and where a stock is fed year after year in just the same way, the flock, by a process of natural selection, eventually is made up of individuals that the method of feeding suits. The others do not thrive and are gradually eliminated from the flock.



THE LAST BITE BEFORE GOING TO ROOST IN THE EVENING

Beginners in poultry keeping usually have a great deal more trouble in feeding than those with longer experience, not merely because of the beginner's lack of experience and knowledge of feeding, but because the stock is being adjusted and adapted to a new diet—one that perhaps suits a part of it better than that to which its race has been accustomed, but is likely to be more or less unsuited to another part of it. If—as is usually the case—a beginner's stock is from a number of different flocks, he is likely to get uneven results the first year. The next year the results will be more uniform because that part of the stock to which the ration was ill adapted will have been culled out, and those to which it was at first not particularly well adapted will generally have become accustomed to it.

A poultry keeper can adapt his stock to almost any ration or system of feeding that supplies the necessary nutritive elements with reasonable regularity, or he can develop a stock that takes kindly only to rations similar to those to which they have been accustomed and that, to give best results either in growth or in egg production, has to be humored a good deal in the matter of eating; or he can develop a stock that will eat at any time anything suitable for poultry that is offered it. The use of rations with a few ingredients and rigid adherence to the same schedule of feeding day after day tends to make chickens "fussy" about what they eat. Chickens may be

got so into the habit of eating certain things at certain times that until starved into it they will eat at any particular feeding time only the feed they have been accustomed to get at that time. Cases of this kind are much more rare since the practice of keeping feed before the chicks in hoppers came into general use, but there are still far too many flocks of growing chicks that are never broken to take good feed as offered to them.

By giving from the first enough variety in feeds for the chicks to learn that what the feeder puts before them will satisfy their appetites and that nothing else is to be expected until it is gone, chicks are soon taught to eat readily of any feed offered that is not actually unpalatable or objectionable. Also by changing the order of feeds given at different times through the day they are trained to eat anything at any time. Chickens that are so trained are not as a rule subject to digestive disorders when changes in their ration are made; and though the writer cannot positively affirm that it is so, it is his opinion that by varying the order of the feeds quite frequently, and avoiding the monotony of feeding on rigid schedules, feeding practice is adapted to a much larger proportion of chickens generally. In other words, it appears to him that it is the monotony of most poultry rations, rather than the nature of any of their ingredients that is the true cause of the lack of what may be called energy in digestion which causes temporary trouble when chickens are given an unaccustomed feed.

There is no inconsistency between training chicks to eat what (proper) feed is set before them, and catering to their appetites with the most appropriate feed at certain times. On the contrary, the two policies are complementary. We train the chicks to take their ordinary rations freely under all ordinary circumstances; and on the other hand we give particular attention to furnishing the diet that will at the same time best promote growth and keep the chicken hearty under extraordinary and unfavorable conditions for development.

Culling and Separating Chicks in the Growing Period

While as previously stated it is desirable to put in one coop or house at weaning time only as many chickens as can be carried to maturity in it, this ideal condition is found so seldom, that further separation and culling of flocks of growing chickens is almost always necessary. In the more precocious breeds, of which the Leghorn is the most popular representative, it is best to separate the pullets and cockerels at weaning time, but in the medium-sized breeds they may be kept together much longer,—until three, four, or five months of age, without the cockerels annoying the pullets.

In the Asiatic breeds, and the larger and slower maturing strains of the general-purpose type, the sexes may be kept together until nearly or quite full grown without the young males annoying the females at all. Different strains vary in this respect, but nearly always Asiatic males of stocks that grow to good standard size are altogether indifferent to the females until they approach their full size and physical development.

Where the males are to be used for roasters, and fattened and sold for that purpose just before they begin to show sexual proclivities and their meat would become hard and staggy, it is often a great convenience to keep cockerels and pullets together up to the time that the former should be taken out for fattening. In the case of early chickens, this may allow running the sexes together until about July 1st, in the North, and then, with the cockerels removed, the number of pullets left in each lot will have plenty of room both indoors and out during the remainder of the growing season.

Similarly where pullets and cockerels for stock birds have been kept for a while after weaning with pullets intended for layers, as the season advances and the growing chickens begin to crowd the house, those of one class can be taken from it to other quarters, leaving the other class to occupy it the remainder of the season;—the best conditions being given to the stock intended for breeding purposes. Where only the few cockerels a poultry keeper reserves for his own breeding are kept, it is often a good plan to give them a fair-sized yard and special feeding, that the pullets—both for breeding and laying—may have all the available range undisturbed. Where there is room to do so, the best way to handle the cockerels reserved for breeding is in colonies so far away from all other stock that they do not come in contact with either hens or pullets where they range.

For a generation past, so much of our poultry has been grown close about groups of farm buildings, or on the limited ranges of rather intensive poultry farms, that it is not generally known that when they have the opportunity to do so cockerels and pullets which return to the same coops or roosting places at night will voluntarily separate and go to different ranges during the day, showing the instinct in this which seems to be common to polygamous birds at other times than in the breeding season, and which is often noted in turkeys. This point is of interest because it shows that the tendency of young cockerels to annoy hens and pullets is due to the abnormal life they lead, and that if they are given the opportunity to range where there is an abundance of the things chickens like, to be secured by foraging, they will take little interest in anything but the business of eating and keeping as comfortable as possible. This applies to cockerels of the precocious breeds as well as to others. The writer has seen the cockerels and pullets in a flock of nearly a hundred growing Leghorns that had the range of some six or seven acres of land, and that were fed together night and morning, go to different trees to roost, and in separate bands appropriate each its part of the range and never trespass on that of the other throughout the whole season.

As most chickens are housed during the period of growth in rather larger numbers than is consistent with their best development, culling out the inferior specimens as fast as they are noted as distinctly inferior, or as undesirable to carry to maturity, is one of the most effective ways of improving conditions for those that remain, and thus getting the greatest possible returns on the feed that they consume and the labor expended upon them. There is no greater fallacy in regard to the feeding of growing chickens than the idea that the way to avoid loss on unthrifty chickens is to carry them along with the rest until maturity, and try to make as much as possible of them. The common impression is that unthrifty and undersized chickens are light feeders, and that if they have not grown as much in a given time as their more thrifty companions, neither have they cost as much. The fact is that the unthrifty chickens consume far more feed to make a pound of weight than the others. They are unthrifty because they have not strong vitality and good digestion, and a large part of what they consume passes through them undigested.

It does not pay to keep an unthrifty chicken after that characteristic is noted. It should be eaten or sold for whatever it will bring. It simply cannot convert feed into poultry meat at a profit, and the longer the owner

keeps it the more he loses on it. The general tendency in poultry growing is to do the culling at stated periods. Most poultry growers will throw out the cripples and a few conspicuously feeble chickens when taking them from the nest or incubator; cull out the unthrifty specimens at weaning age (and try to fatten them for broilers); and take out a few more of the worst when the flocks go into winter quarters. Whenever a poultry grower, noticing a chicken, thinks—" It doesn't look very promising, but with good care it may amount to something," the best thing he can do is to make meat of it with the least possible delay. The more closely he adheres to this policy, the more good chickens he will have at the end of the season, and the less they will have cost him. Only where a farm range affords abundance of feed can unthrifty chickens be grown without loss.

Weights That Represent Good Growth at Various Ages

A novice in poultry keeping is often doubtful of the value of his own opinion as to whether his chickens generally, or any particular ones among them, are making satisfactory growth. The reliable test of this point is the known weight of the chicks at known ages. The United States Department of Agriculture, from records of weights of chicks grown at its poultry farm at Beltsville, Md., issued in 1918 a tabulation of weights of White Plymouth Rock, White Wyandotte, Rhode Island Red, Buff Orpington, and White Leghorn chickens up to 28 weeks of age which gives growers an excellent standard for testing the results of their work. Several of the State Experiment Stations have published reports of experiments which show both the weights of chickens at various ages, and the amounts of feed consumed to make these weights. Some of these results are given in the following tables:

UNITED STATES DEPARTMENT OF AGRICULTURE DATA ON WEIGHTS OF CHICKENS AT VARIOUS AGES

Table showing the age in weeks and tenths of weeks at which chickens of the breeds named reached the weights indicated in pounds at the top of each column, and average weight for the period of growth observed.

Males	1 lb.	2 lb.	3 lb.	4 lb.	5 lb.	6 lb.	7 lb.	8 lb.	9 lb.	Av. Wt.	Age Wks.
White Rock	6.7	9.6	12.3	14.7	17.2	20.1	24.3	26.3	.....	7.73	28.
White Wyandotte	7.3	11.6	14.6	17.3	22.1	24.	.....	.....	.....	5.43	24.7
R. I. Red	7.8	11.6	14.7	18.5	23.	24.5	.....	.....	.....	5.4	25.8
Buff Orpington	7.5	11.	14.	16.2	18.5	21.	23.	24.	27.	7.2	25.
White Leghorn	8.	11.8	16.6	22.5	.....	.....	.....	.....	.....	4.26	28.
Females											
White Rock	7.6	11.3	14.4	18.5	22.6	25.8	.....	.....	.....	6.07	28.
White Wyandotte	7.3	12.	15.7	20.7	25.	.....	.....	.....	.....	5.17	26.
R. I. Red	8.6	13.3	14.8	24.3	.....	.....	.....	.....	.....	4.48	27.4
Buff Orpington	7.6	11.6	14.8	18.6	23.3	.....	.....	.....	.....	4.9	24.
White Leghorn	9.	15.	24.5	.....	.....	.....	.....	.....	.....	3.14	26.5
Both Sexes											
White Rock	7.15	10.5	13.3	16.6	19.9	22.9	.....	.....	.....	.....	.....
White Wyandotte	7.3	11.8	15.1	19.	23.5	.....	.....	.....	.....	.....	.....
R. I. Red	8.2	12.4	16.5	21.4	.....	.....	.....	.....	.....	.....	.....
Buff Orpington	7.55	11.3	14.4	17.4	20.9	.....	.....	.....	.....	.....	.....
White Leghorn	8.5	13.4	20.5	.....	.....	.....	.....	.....	.....	.....	.....

The memorandum published with this table says: "The recorded weights from which the above figures were computed were for lots of chicks selected at random from each breed at hatching to give a fair sample of the stock. Weighings were made at hatching and at intervals of one week up to 24 to 28 weeks, as seemed necessary. The White Plymouth Rock cockerels made on the average nearly full standard weight of 8 pounds in less than 28 weeks. The White Rock pullets made on the average over standard weight of 6 pounds in the same time. The White Wyandotte stock is standard weight, but the cockerels run under standard weight, of seven and one-half pounds. In fact the standard weights for the sexes in this and some other breeds are disproportionate, and the same mating will not produce both sexes to make standard weight in a given period as regularly as in the case of the White Rock stock on this farm. The Rhode Island Red stock observed is rather under standard weights. The Buff Orpington records were for only one season, and the observations were not continued for all the birds through the full period of growth. The figures given, however, fairly indicate what may be expected of average good growing Orpingtons in the period designated. The White Leghorns are of ordinary average size, with some specimens well above the average."

THE SAME DATA IN DIFFERENT FORM—EASIER TO APPLY

Transposing the results in the above table, stating the age in weeks, and the weights which chickens of the several kinds should make at that age.

White Plymouth Rocks Should Weigh

BOTH SEXES:

At 8 weeks	1 pound
At 11 weeks	2 pounds
At 14 weeks	3 pounds
At 17 weeks	4 pounds
At 20 weeks	5 pounds

COCKERELS:

At 7 weeks	1 pound
At 10 weeks	2 pounds
At 13 weeks	3 pounds
At 15 weeks	4 pounds
At 18 weeks	5 pounds
At 20 weeks	6 pounds
At 24 weeks	7 pounds

PULLETS:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 15 weeks	3 pounds
At 19 weeks	4 pounds
At 23 weeks	5 pounds

White Wyandottes Should Weigh

BOTH SEXES:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 16 weeks	3 pounds
At 19 weeks	4 pounds
At 24 weeks	5 pounds

COCKERELS:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 15 weeks	3 pounds
At 18 weeks	4 pounds
At 22 weeks	5 pounds
At 24 weeks	6 pounds

PULLETS:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 16 weeks	3 pounds
At 20 weeks	4 pounds
At 25 weeks	5 pounds

Rhode Island Reds Should Weigh

BOTH SEXES:

At 9 weeks	1 pound
At 13 weeks	2 pounds
At 17 weeks	3 pounds
At 22 weeks	4 pounds

COCKERELS:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 15 weeks	3 pounds
At 19 weeks	4 pounds
At 23 weeks	5 pounds
At 25 weeks	6 pounds

PULLETS:

At 9 weeks	1 pound
At 14 weeks	2 pounds
At 19 weeks	3 pounds
At 25 weeks	4 pounds

Buff Orpingtons Should Weigh

BOTH SEXES:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 15 weeks	3 pounds
At 18 weeks	4 pounds
At 21 weeks	5 pounds

PULLETS:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 15 weeks	3 pounds
At 19 weeks	4 pounds
At 24 weeks	5 pounds

COCKERELS:

At 8 weeks	1 pound
At 11 weeks	2 pounds
At 14 weeks	3 pounds
At 16 weeks	4 pounds
At 19 weeks	5 pounds
At 21 weeks	6 pounds
At 23 weeks	7 pounds

White Leghorns Should Weigh

BOTH SEXES:

At 9 weeks	1 pound
At 14 weeks	2 pounds
At 17 weeks	2½ pounds
At 20 weeks	3 pounds

COCKERELS:

At 8 weeks	1 pound
At 12 weeks	2 pounds
At 14 weeks	2½ pounds
At 17 weeks	3 pounds
At 23 weeks	4 pounds

PULLETS:

At 9 weeks	1 pound
At 15 weeks	2 pounds
At 20 weeks	2½ pounds
At 25 weeks	3 pounds

Purdue Experiment Station Report on Feed Consumed by White Plymouth Rocks in Growing Period

At the Purdue University Agr. Experiment Station La Fayette, Ind., in 1916 and 1917, records of the consumption of feed and of the weights of White Plymouth Rock chickens at intervals during the entire growing period were kept for two large lots of chickens, nearly 200 being in the first experiment, and about 250 in the second. The chickens in each case were kept all together while they required brooding. When they no longer needed heat, the pullets were placed in one lot and the cockerels in another, about one-third of the cockerels having been caponized. The records for the cockerels were kept for 24 weeks. At the end of that time those in the first experiment averaged 6.4 pounds each; those in the second experiment 6.46 pounds each. The capons were kept until 41 weeks old, and averaged to weigh when sold—in the first experiment, 9.91 pounds; in the second, 9.37 pounds. The records for the pullets were kept for 28 weeks, at which age about half of them were laying and the average weight was:—in the first experiment, 5.56 pounds; in the second, 5.73 pounds.

Considering the numbers of birds involved the results in these two experiments are remarkably uniform and the weights show good work on the part of the grower. Both in these figures and in those in the preceding report, it should be noted that, with the averages as given, a great many individual birds are considerably above the average, and—of course—about an equal number considerably below it.

CONSUMPTION OF DIFFERENT FEEDS IN POUNDS PER BIRD

Experiment No. 1—1916

Feed	Chicks	Pullets	Cock'ls	Capons
Cracked corn	1.44	.....	.....	.....
Cracked wheat	0.19	.....	.....	.....
Whole wheat	1.25	8.44	7.75	10.5
Steel cut oats	0.19	.....	.....	.....
Ground oats	0.24	1.1	1.35	0.77
Shorts	0.24	1.5	1.46	2.38
Bran	0.24	1.5	1.46	1.61
Corn meal	0.24	1.5	1.46	3.10
Meat scraps	0.24	0.8	1.14	0.91
Milk	7.6	17.0	15.87	31.70
Charcoal	0.08	0.1	0.10	0.09
Grit	0.1	0.1	0.08	0.19
Ground bone	0.08	0.1	0.06	0.19
Corn	.....	10.2	7.77	12.00

The full amount of feed consumed by each pullet in 28 weeks is found by adding the figures in the columns for chicks and for pullets; the full amount for the cockerels for 24 weeks, by adding the figures in the columns for chicks and for cockerels; and the full amount for the capons for 41 weeks by adding to the figures for cockerels those in the column for capons. The figures in the column for pullets show the average consumption for each pullet from the time of weaning at 9 weeks, to the age of 28 weeks, the time they were on the range. The figures in the column for cockerels show the average consumption of each cockerel, and of each capon, from 9 to 24 weeks. The figures in the column for capons show the average consumption of each capon from 24 to 41 weeks. None of the figures include green feed of which the birds consumed large quantities on range.

Experiment No. 2—1917

Feed	Chicks	Pullets	Cock'ls	Capons
Cracked corn	2.3	4.7	.....	.....
Cracked wheat	0.1	.....	.....	.....
Whole wheat	0.92	3.4	2.6	2.8
Steel cut oats	0.1	.....	.....	.....
Ground oats	.....	.....	.....	1.32
Shorts	0.49	1.6	1.8	2.74
Bran	0.49	1.6	1.8	1.42
Corn meal	.....	.....	.....	3.97
Meat scraps	0.24	1.0	1 1	0.8
Milk	6.54	30.6	15.4	50.5
Charcoal	0.01	0.02	0.01	0.02
Grit	0.06	0.08	0 04	0.18
Ground bone	0.05	0.2	0.1	0.22
Corn	.....	.....	5.2	6.45
Prepared feed	.....	7.45	7.0	2.8
Whole oats	.....	1.89	.....	14.76

These two experiments are especially interesting and valuable because of the remarkable uniformity of results secured with quite different rations. As will be noted, the second experiment was made in the year 1917 when war conditions were sending prices of feeds up and making it difficult to get feeds. The ordinary rations used for chicks at Purdue are given in Nos. 10 and 10a in the lists of rations for chicks in this book. As to feeding in the latter part of the 1917 season the report says:—"During the summer months the grain rations were changed to meet the feed-cost conditions. When the prices of corn and wheat became so high, a prepared scratch feed was purchased in large quantities; later, oats were used as the only grain. When new corn became available, soft corn on the cob was purchased at a reasonable price, and used as grain. During the last three weeks of both experiments the capons were fed a wet mash to insure a good finish."

Ontario Experiment Station Report of Feed Consumed by Growing Chicks

"We were able in 1909 to keep an exact record of the birds grown in a pasture field and of those grown in an orchard. The chicks in the pasture field were hatched during the first two weeks in May. Three hundred and forty-five birds were grown to maturity or to a size suitable for fattening. We began to remove the cockerels from the fields to the fattening pens on August 25th. The pullets and cockerels held for breeders were all taken from the field by the 22nd of October. The breeds were Orpingtons, Wyandottes, Plymouth Rocks, Leghorns, etc. They consumed 4,304 pounds of grain; of this about one-third would be dry mash, nearly 300 pounds chick feed, and the balance wheat, corn, and hulled oats in the proportion of two and a half, two, and one. There was five per cent of beef scrap added to the dry mash. The birds were weighed when taken from the field, weighing 1,341 pounds, or one pound of chicken representing 3.2 pounds of grain. Some of the breeding cockerels weighed over seven pounds, and the Leghorn pullets did not average three pounds in weight. We removed most of the cockerels at about three and one-half pounds weight, or when they would fatten most economically.

"The chickens reared in the orchard varied more in age. The first were hatched on the 25th of April and the last on July 6th. Most of the birds were hatched in May. We sold 218 as broilers from this lot during July. The later cockerels were removed to the fattening crates as was done with those grown in the pasture field. Most of the pullets were taken out about the first of October, and by the first of November practically all had been removed with the exception of about 100; these were cockerels held as breeders, and the July chicks. We raised in this field 733 chickens at a cost of 8,649 pounds of grain. A pound of chicken equaled 3.34 pounds of grain, or nearly the same as the pasture-field chickens. The figures mean that a farmer can in his field raise a four-pound cockerel for thirteen or fourteen pounds of grain."

What the Average Farm Flock of Chicks Can Get From Farm Range

In both of the above instances the flocks of chickens were larger, and also more limited for range—in one sense—than the average farm flock which roams where it pleases. These experimental flocks had good range, as far as vegetable and animal feed supplies were concerned, but got little or no grain from their range. At the Ontario Station the chickens are given new land each year, land

that is hygienically clean and supplies them with the feed accessories. They are an animal crop in a rotation of principally vegetable crops. On the ordinary grain, grass, and stock growing farm, where the number of chickens is rarely more than 200 to 300 and the chicks can have the range of many fields, it is often possible, by distributing the chickens as widely as is practical, and by moving the coops several times in the course of the season, to have them eat a large amount of grain that would otherwise be wasted. When it is considered that the ordinary waste of small grains in handling in the field at harvest is about five per cent of the yield, and that in ordinary threshing as much more is left in the straw, and that the wastes often greatly exceed this, it is easy to see that a farm with from sixty to a hundred acres or more in grains of various kinds and grass has waste grain enough to grow quite a large stock of poultry—provided the birds are distributed where they can get the grain, and shifted on the land to cover it all during the season.

Reports are frequently made of farm flocks of chickens up to 200 or more that are fed little grain from the cribs. Knowing the amount of grain that it takes to make a certain weight of chicken under the conditions in the experiments that have been cited, we can make close estimates of the amount of waste feed salvaged by a flock that gets practically all its grain from the land. One hundred chickens raised to an average weight of three pounds will each have consumed about ten pounds of grain—a thousand pounds in all. One hundred six-pound chickens will have consumed a ton of grain. Of grains as they are found on the farm fields and in the yards there would be from forty to fifty bushels, according to the relative proportions of oats and of heavier grains.

On the farm that grows considerable quantities of grain, the question of feeding poultry is one of using the waste grain to best advantage. It will not in every case be most profitable to plan to have poultry use all the waste grain, but there will always be a great deal of it that poultry can glean to better advantage than anything else, and the farm plans for poultry keeping should be designed to get the most out of this. While for the purpose of illustration we have discussed the possibility of a considerable flock of chickens getting all their grain from the farm, that may not always be the best plan. In many cases it will be more profitable, on the whole, to plan the poultry keeping with a view to having stock enough to consume the large wastes of grain within a comparatively short time after they are available. This may mean feeding more or less salable grain at other times.

Another point which the farmer who has much waste grain available for poultry at some seasons should consider is that, except when such wastes are abundant and easily obtained, leaving poultry to find all feed for themselves compels them to work too hard for what they get, —to use up in energy much nutriment that could more profitably go to growth, and makes chickens too hard-meated to be really first-class table poultry. Many farmers have so much other work to do that the most profitable method for them to follow with poultry is to keep just enough to stock the range that they can use for poultry, and leave the birds generally to themselves. But wherever it seems advantageous to give special attention to poultry on the farm, it will be found profitable to carry stocks of chickens much larger than the range will supply with the grain needed, adopting to some extent the policy of growers of first-class market poultry, who go on the principle of giving chicks free range, but feeding them so well that they will take only exercise enough to keep them in good condition until fit for market.

A course about midway between this practice of market poultry growers and that of the farmer who makes his chickens hunt for most of their feed, will give full growth and vigor without making young birds noticeably hard-meated. A farmer who distributes his chickens so that the grain they get from the land will equal about half of the usual grain ration, and finds that he gets a normal rate of growth by feeding about half the quantities of grain consumed by chickens on a range that affords no substantial amount of grain, may conclude that he is growing chickens about as they should be grown for laying and stock purposes, still keeping them so soft-meated that when properly finished for market they will be quite as tender as those which the market poultry specialist keeps soft-meated by feeding so that they take the least amount of exercise that will keep them from indigestion until they are fattened for market.

Observations on Various Relations of Feed and Conditions of Feeding to Growth and Development

Chickens from the same stock may be grown in about the same time to the same weight, and yet develop on such different lines that they appear to be of quite distinctly different types. This is most noticeable in standard exhibition stock from the same breeder, grown by various purchasers of eggs under different conditions, but it may easily be observed by comparing stock of the same breed as grown by different breeders for different purposes. A ration with a large proportion of soft feed will grow a different type of chickens from one with a large proportion of hard feed. A ration in which corn is the principal ingredient will grow a different type of chicken from one which contains mostly wheat or barley. A ration containing a large amount of meat will have a different effect on the development of the comb and wattles from one containing no meat. Feeds will modify development just as conditions may.

Soft feed, and feed of which chickens are very fond and of which they eat freely, tend to make coarse-boned, loose-jointed birds which, because of these characteristics, develop quite a different carriage from what they would have had on a harder diet of which they ate more sparingly. If with the feed that makes for bulk, looseness of frame, and coarse bone, we have conditions of life that also tend to these results, the effects are aggravated. On the contrary, if we give conditions having an opposite tendency to that of the ration, we can neutralize effects if they are undesirable. Whether they are undesirable will depend upon the purpose for which the birds are to be used.

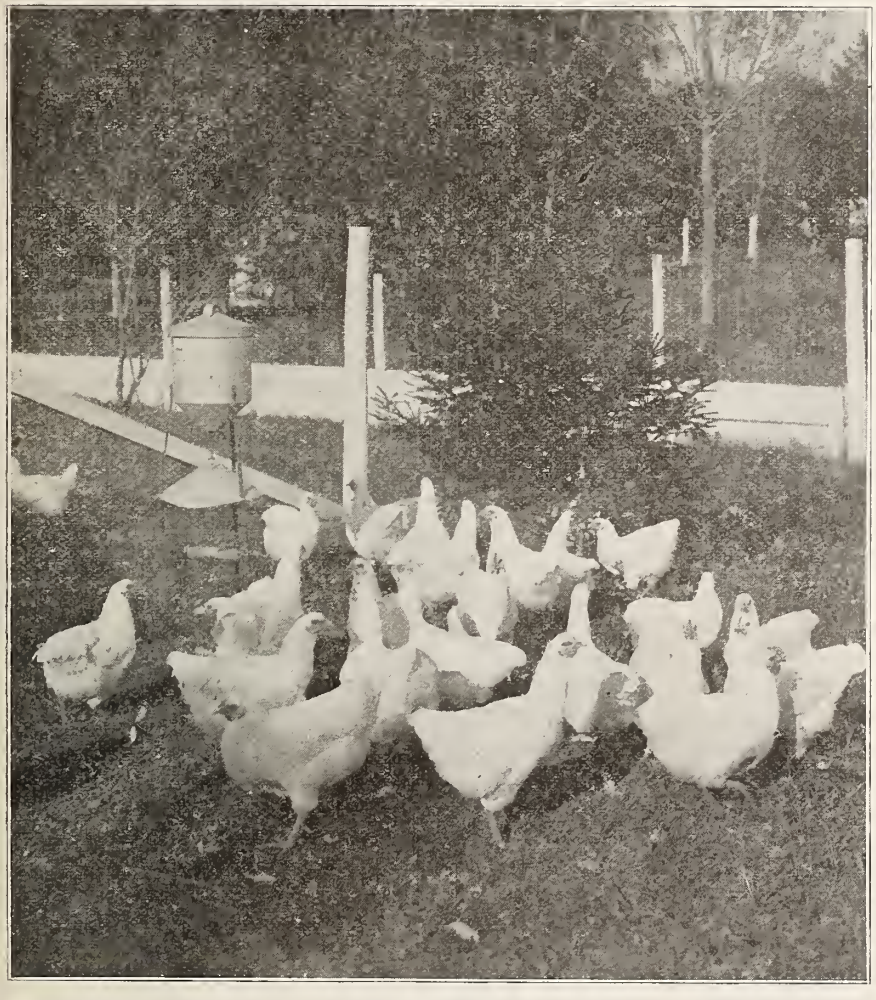
Many growers of standard exhibition stock give little or no meat to growing chicks, because of the tendency of meat to make the comb and wattles large and coarse. Obviously the objection to the feeding of meat in such cases will be most in evidence in stocks where the tendency is to a larger comb than is desired; and in stocks with rather small combs it will be possible to feed meat quite freely without getting objectionable coarseness in comb and wattles. Where meat is withheld for the purpose named, it is necessary and customary to give the birds every other possible advantages to make good growth.

The feeding of yellow corn and corn meal to poultry increases the yellow color in fat and in the skin, the scales of the legs, and the beak. It also commonly increases the creaminess of white plumage, though it does not invariably do this, for there are some birds and some stocks in which the yellow color does not appear in white plumage no matter how much yellow corn is fed. In this matter

the poultry keeper must act according to the circumstances. Breeders of white varieties generally try to develop in their stock the absolute white plumage. This is difficult, and also is a slow process. Meantime it is good policy for one who finds that yellow corn affects the plumage of his white poultry to an undesirable extent, to refrain from using it. In England and on the continent of Europe where there is more or less prejudice against yellow color of the skin and yellow fat in poultry, the market poultry growers avoid feeding yellow corn and meal. In the United States the yellower the poultry the better it pleases the consuming public, so the grower of market poultry feeds all of both that his poultry will stand.

Feeding Chickens in the Fall

With the coming of decidedly cool nights in the fall, vigorous, healthy chickens usually develop tremendous appetites. With due attention to the modification of heavy rations in the occasional hot spells that still come during September in the North and may be looked for even a month later in the South, the chickens should be fed all that they will eat of good, substantial rations. Those that are being fed at this season are mostly pullets for layers stock birds, and cockerels that were not ready to market when prices were good in the early summer, or that were not sold then simply because the grower (as is the case on many farms) follows the custom of letting all chickens, except what are consumed at home through the season, grow until late in the fall, and then make a general clean-up of the stock that is not to be carried over, reserving what pullets and hens are wanted, and a few cockerels, and selling all the remainder.



WELL-GROWN PULLETS IN GRASSY YARDS WITH AUTOMATIC GRAIN FEEDER

It is usually the best policy in poultry keeping to have the stock at this season down as close as possible to what is to be carried through the winter. Breeders who sell breeding stock, of course, have to carry a considerable part of it well into the winter, and perhaps some of it until spring, but in nearly all other cases the poultry keeper who sells all cockerels that are not to be used for breeding, or that have not been caponized in the summer, and works off as table poultry his cull pullets and all hens that are not regarded as promising layers for another year, doing this as early in the fall as possible, is in a much better position to handle the stock on hand to the best advantage.

The common difficulties in feeding—and in getting the results that should be obtained—at this season, are the the overcrowding of stock, and short-feeding, either as a result of shortage of feed on ranges that were good through the earlier part of the season, or because the cost of feeding a large stock at a time when returns from it are small is such a burden that the owner adopts the mistaken policy of feeding a little light, in order to make the feed (and his money) go as far as possible. In all management of live stock, the only sound policy is to keep only those that are worth feeding for the purpose for which they are kept, to keep only as many as the land or the resources in feed and money will carry, and to feed at all times all that the creatures can use to good advantage. Any other course defeats its own ends. Adjustment to get the right conditions is simply a matter of culling rigidly and culling early. When this is done, the unprofitable and least profitable individuals are weeded out, reducing the number to be fed, while the receipts for those sold become available to buy feed for the others.

The poultry keeper can more fully appreciate the occasion for heavier feeding at this time if he will consider that the chickens are mostly now not more than three-fourths grown, that even at summer temperatures their requirements for growth are steadily increasing, and that with every decline in the average daily temperature the chickens, to keep up their normal rate of growth, must have more heat-producing feed. These two things call for large increases in the feed consumed, and in addition, it is the natural tendency of poultry to put on fat at this time in anticipation of coming cold weather when the demands for heat will at all times be beyond the heating capacity of the ration that they can digest. Thus coming altogether, we have practically a trebling of the rate of increase in feed requirements that obtained through the summer.

To keep chickens growing right it is necessary to provide fully for these increased requirements, giving the birds all that they can eat and digest. Where whole corn is available it may be fed freely at least once a day.

preferably the last thing at night. Where cracked corn and meal only can be had, it is a good plan to increase the proportions of both in the ration and also to increase the amount of animal feed as long as the chickens will eat increased amounts in their mash with relish, or —when it is fed separately—give them all they want. With these increases in the more concentrated feeds, vegetable feeds and milk should be supplied as freely as possible. Waste windfall apples in quantity will go a long way toward feeding poultry, and they are widely available. Frequently large quantities of cabbage that have come on a little too fast for winter storage and have split heads are available for poultry feeding, or may be bought in quantity at prices that make them economical feeds. Anything on his place, or in his vicinity, that poultry will eat, and that it appears will otherwise go to loss, a poultry keeper should secure for his poultry.

Where such supplies are abundant and the stock of poultry not large, they may make so much of the feed that the grain requirements are reduced, but in general, the birds will consume as much grain as ever, or perhaps more; the advantage and the saving are not in actual reduction of the amounts of grain used, but in keeping the chickens growing at the best possible rate and getting them to full growth and maturity as soon as possible. Many people are afraid to feed pullets heavily as they approach maturity, for fear of getting them too fat to lay. There is not the least danger of that except where they are grown in very restricted quarters and with much less green feed than is necessary to keep them in good condition. The question of the relation of fat to egg production will be considered in detail in connection with that subject in the next chapter. Here it is only necessary to say that when pullets are grown under such conditions and on such rations as will produce pullets with the development and the constitution required to make them profitable layers, there is not only no danger of preventing their laying by heavy feeding at this period, but the heaviest feeding they can stand and keep good appetites is what they need to bring them to laying as soon as they are full grown.

Relation of Poultry Parasites to Feeding and Feeding Results

Whatever diminishes the comfort and vitality of a creature unfavorably affects digestion and production. We can see this most plainly in milch cows which are fed and yield their product under conditions that bring out clearly the influence of excitement or discomfort upon appetite, digestion, and the flow of milk. The individual peculiarities of cows are noted because cows have to have individual treatment in feeding and milking. Similar peculiarities in hens are not so likely to be noted, because the unit in poultry work is a flock, not an individual. The variations in the quantity of milk given by a cow are conspicuous because she is milked at regular intervals and the amount of milk is expected to be the same from day to day. Anything disturbing to the cow is so certain to be followed by a reduction in the quantity of milk at the next milking that the person in charge of the cow has to be very obtuse not to see the relation between the cause and the effect.

In the care of laying hens fluctuations in the egg yield on account of disturbances are not as plain as the corresponding developments in connection with milk production, but still are often apparent to ordinary observation. In growing chicks, even at the most rapid rate of growth, the daily increase is not so noticeable that the effects of things that check growth will be immediately noticed. It is often only after a check has been operating for several days or a week or more that its cumulative effects attract attention. Because of this it is necessary for a poultry grower, and especially for a novice, to guard against the development of conditions that may unfavorably affect growth. In earlier sections in this chapter instructions were given in regard to anticipating the effects of extreme heat upon appetite and growth, by suitable adjustments of the diet. Equally important is the matter of the relation of parasites to the consumption and digestion and assimililation of feed.

The presence in small numbers of lice and mites on adult poultry, or poultry that is nearly grown, does not appear to be particularly detrimental to them. It is not unreasonable to suppose, as some do, that the body lice in moderate numbers may be beneficial, the irritation they cause stimulating the bird to wallow in the dust, which process results in cleaning the plumage as well as destroying most of the parasites. The parasites that consume dead skin are of some use, and it is not at all impossible that the blood sucking mites do some service by taking blood from birds that have too much blood pressure. But the increase of parasites from harmless to harmful numbers may be made so quickly, and with such serious effects upon growing chickens, that the poultry grower needs always to keep this situation well in hand, taking whatever measures are necessary to keep lice and mites in subjection.

Head and body lice of poultry are most troublesome while the chicks are small. Red mites do most of the damage during the summer. The effective way to keep them down is by thoroughly spraying with a good liquid insecticide and disinfectant all coops and houses occupied by growing chickens. They should be sprayed before chickens are put into them, watched closely for the appearance of mites, and sprayed as often as signs of these are seen. Spraying at regular intervals is frequently recommended, but in the writer's opinion it is generally better to keep a sharp lookout and spray when necessary. In hot, damp weather mites sometimes multiply with amazing rapidity, and those who rely upon regular sprayings and do not watch closely for mites often overlook an inroad of them that may start soon after a spraying, until it has done a great deal of damage.

Either lice or mites in sufficient numbers can completely neutralize the effects of the best of rations, and the best of conditions in other respects. They sap the vitality of the birds, diminish their appetites, impair their powers of digestion, and take the profit out of the poultry growing. Nor are the effects of lice and mites seen only in these general respects. In the growing of exhibition poultry, the diminished vitality of the birds due to the presence of lice or mites, or both, affects the development of the feathers, making faults that would not otherwise be present; and may also notably affect the carriage and type of the bird. Poultry may live while infested with lice, but they will not thrive if lice cause them any serious discomfort or annoyance.

CHAPTER VII

Feeding For Egg Production

Feeding and Management of Hens of All Types and Breeds to Secure Heavy Egg Production—Laying Rations Used and Recommended By Federal and State Demonstration and Experiment Farms, and By Commercial Egg Farmers—Amounts of Feed Consumed By Laying Hens—Modifying Rations to Suit Weather Conditions

ONE of the easiest things in poultry keeping is to get good egg production. It can be done quite easily under conditions in which it is difficult to grow good chickens and in which good results from breeding stock are rarely obtained. Why is it, then, that so many people strive unsuccessfully to get even ordinary egg yields and so few report extraordinary yields? It is simply because so many people are looking for some way of getting good egg yields by some other process than that which regularly gives them. The way to get good egg production, while in itself easy, is not equally attractive to all who engage in poultry keeping. It is close attention to the wants of the hens, regular feeding of rations furnishing a good variety of feeds, care of the birds and the premises they occupy to keep them comfortable under changing weather conditions, and to keep the place they live in reasonably clean. The routine of attention to these details may sometimes be simplified by the use of appliances and a system of management that reduce the number of times that attention is given to the birds daily, but in general when good egg yields are obtained, some interested and responsible person is looking after their wants not less than twice, and oftener three times, a day.

It is best to recognize this fact at the beginning of a discussion of feeding for egg production. The cases where good results are obtained with less attention are exceptions in which an unusually favorable combination of other things affecting egg production has made it possible for a poultry keeper to get good to extra-good production with a minimum of attention. The consideration of these exceptional cases will be taken up after discussion of feeding for egg production under the usual conditions which give ordinary good results. In discussing this general line of feeding for egg production we will begin with the pullets in the fall, and consider the management of a flock from the time they are first put into the laying houses, through the winter, spring and summer, and the first annual molt, bringing them up to the beginning of their second laying year. Before going into the details of handling and feeding under ordinary conditions, it will be worth while to consider the conditions under which pullets lay according to expectation promptly upon reaching the age of maturity.

The Ideal Way to Manage Pullets for Egg Production

The surest way to have pullets begin to lay about the time they make their growth, and continue to lay regularly, is to grow them in the house that they are to occupy as layers. This is not commonly practiced because, after maturity, layers do not need as good range as they had while growing, and because, as a rule, the houses for the laying stock are occupied by the preceding generation of layers throughout the greater part of the period when the pullets are grown. The reason pullets handled in this way are normal in regard to the time of beginning laying, while apparently as well grown pullets that have been shifted several times during the growing period, with the last shift (to permanent laying houses) coming just about the time they are expected to begin to lay, will be weeks and possibly months in getting into regular laying, is—that unless such shifts are made with the greatest care to keep the birds quiet, comfortable, and contented, every move checks development and retards egg production.

This effect of change is found in nearly every function of poultry that has to be considered in connection with growth and reproduction. Mention was made in the last chapter of the effects of change of diet on some birds, and of the importance of using systems of feeding that reduced the susceptibility of birds to such changes. When breeding poultry are moved to new locations, even in the vicinity of their old home, they often do not breed right for some time, but give an extraordinary proportion of infertile eggs and weak germs. Everyone who has moved hens that were laying when moved knows that it usually stops egg production for some time. When these things are considered, it is easy to see how moving pullets about retards laying. The fact that it does is recognized in the practice often adopted of moving pullets that are coming to laying a little too early to suit their owner, and perhaps moving them several times, to hold them back as long as possible. But for every such case there are scores of instances of retarded laying plainly attributable to frequent shifts or to other incidents unfavorable to development during the growing period, and poultry keepers almost invariably either overlook the influence of these things upon development or greatly underestimate their effects.

When to Move Pullets to Winter Quarters

While a change at any time seems to have some retarding effect upon the development of chickens—unless made with such care that they are not in the least disturbed by it—pullets seem to be most suspectible to the influence of change and the excitement that often accompany their establishment in new quarters, in the three or four weeks before they begin to lay. If moved after they have been laying for a little while, with some care to make the change as little disturbing as possible, they will often hardly stop laying at all; but it is quite the common thing for pullets moved just as they were about to begin to lay to produce no eggs for several weeks or months. So whenever it can be done, the pullets should be put in their permanent laying quarters a full month before they are expected to begin laying. The arrangements for moving them should be made with a view to disturbing them as little as possible, and they should be handled gently, even if that does take considerably more time than the average rough-and-ready poultry keeper gives to such jobs.

Rations for Pullets for Egg Production

The feeding of pullets for egg production generally continues, with some modification, the ration they had been receiving while in the growing coops. To keep the

different rations recommended by different institutions and authorities in series that readily connect those from the same place, the following rations have been given the numbers which correspond with the chick rations from the same sources, but with the letter b added:

Ration No. 1b—Rations Recommended By the United States Department of Agriculture

I—Scratch Mixture—Equal parts by weight of wheat, oats and cracked corn. Mash mixture—Equal parts by weight of corn meal, wheat bran, wheat middling, and meat scrap.

Feed the grain twice a day in a litter of straw or other material to compel exercise. A good way is to feed rather light in the morning and heavier at night. The mash may be fed either wet or dry. If fed wet we prefer to give it at noon with the grain feeds morning and evening, but there is no objection to giving the mash either morning or evening, and one of the grain feeds at noon. If the mash is fed dry it should be given in a hopper from which the hens can help themselves at will. If the hens are on good range they will need no other green feed. For hens that have no range in summer, and for all hens in winter some form of succulent green feed should be provided. Oyster shell should be supplied, also grit and gravel if these are not to be obtained from the land.

II—Scratch Mixture—Two parts of cracked corn and one of oats. Mash—Table scraps, run through a meat chopper, and mixed with corn meal, bran, or other ground grain.

Feed the scratch mixture twice a day, the mash once. It is also a good plan with this ration to keep a hopper of the dry mash described in the preceding ration before the hens. Green feed should be furnished as liberally as possible, and the usual feed accessories.

Ration No. 2b—Ontario Agricultural College Ration

I—Method of Feeding Winter Laying Stock.
Scratch Mixture—Equal parts of wheat, cracked corn and buckwheat; this is fed morning and evening. The morning feed is given in litter late the previous evening. The evening feed is given in troughs, and what the birds do not eat is taken up.
Mash—Rolled oats kept constantly before the hens in hoppers.

At noon mangels, cabbage, or clover hay is fed. Buttermilk only is given to drink.

II—Feeding When Wet Mashes Are Used.
Early in the morning scratch mixture as in the above, in litter, at the rate of about half a handful to a fowl. At noon a lighter feed of the grain—about two handfuls to a dozen fowls, and all the roots they will eat. Cabbage is also sometimes given at noon.

(It is obvious that in this case the HANDFULS are large handfuls, what can be scooped in the hand to scatter near the feeder, rather than what could be held in the hand to carry or to throw widely broadcast).

About four o'clock in the afternoon a mash is given. This mash is composed of about equal parts of bran, shorts, oat chop, and corn meal (during cold weather) and to this is added about ten per cent of beef scrap or animal meal—unless cut bone, or cooked meat is available. These feeds are thoroughly mixed dry, and then mixed with steeped clover, prepared by getting a bucket of clover leaves, or cut clover hay, and scalding it with boiling water. This is done early in the morning and the bucket is kept covered with a thick sack throughout the day. The aim is to have about one-third of the ration in bulk cut clover. After the mash a small amount of grain is fed in litter. Water is kept before the birds all the time.

Ration No. 3b—Cornell Ration for Laying Pullets

I—Grain Mixtures. Parts by Weight.
July to about middle of September—1 cracked corn, 1 wheat, 1 oats. September to December—3 cracked corn, 4 wheat, 1 oats. December to latter part of January—4 cracked corn, 3 wheat, 1 oats. Last of January to about March 1st—3 cracked corn, 3 wheat, 1 oats, 1 buckwheat. March to last of July—4 cracked corn, 3 wheat, 1 oats.

Mash—

Corn meal	2 parts
Wheat middlings	2 parts
Wheat bran	1 part
Meat scrap	2 parts
Alfalfa meal	1 part

Grain fed morning and evening in litter—mash fed wet at noon. Grit, oyster shell, and water always before the birds. Mangels and green cut bones given occasionally when they are confined to the house.

II—Same as I, except mash fed dry in hoppers.

Ration No. 4b—New Jersey Experiment Station Ration

I—New Jersey Station Ration.

Scratch Mixture No. 1:

Wheat	100 pounds
Oats	100 pounds

Scratch Mixture No. 2:

Cracked corn	200 pounds
Wheat	100 pounds
Oats	100 pounds
Buckwheat	100 pounds

Dry Mash No. 1:

Wheat bran	200 pounds
Wheat middlings	200 pounds
Ground oats	100 pounds
Corn meal	100 pounds
Gluten feed	100 pounds
Alfalfa	100 pounds
Meat scrap	200 pounds

Dry Mash No. 2:

Wheat bran	200 pounds
Wheat middlings	100 pounds
Ground oats	100 pounds
Gluten feed	50 pounds
Meat scrap	25 pounds

Scratch mixture No. 1 is fed about 9 o'clock in the morning about 5 quarts to 100 birds the year round. Scratch mixture No. 2 is fed at 4 to 5 o'clock in the afternoon, according to the season, about 10 pounds to 100 birds.

Mash No. 1 is kept before the birds all the time in hoppers in winter. In summer Mash No. 2 is used. These mashes are compounded for Leghorns. If fed to heavier fowls the hoppers should be kept closed a part of the day—as much as necessary to insure that the birds will not eat so much mash that they will become too fat.

II—New Jersey Laying Contest Ration.

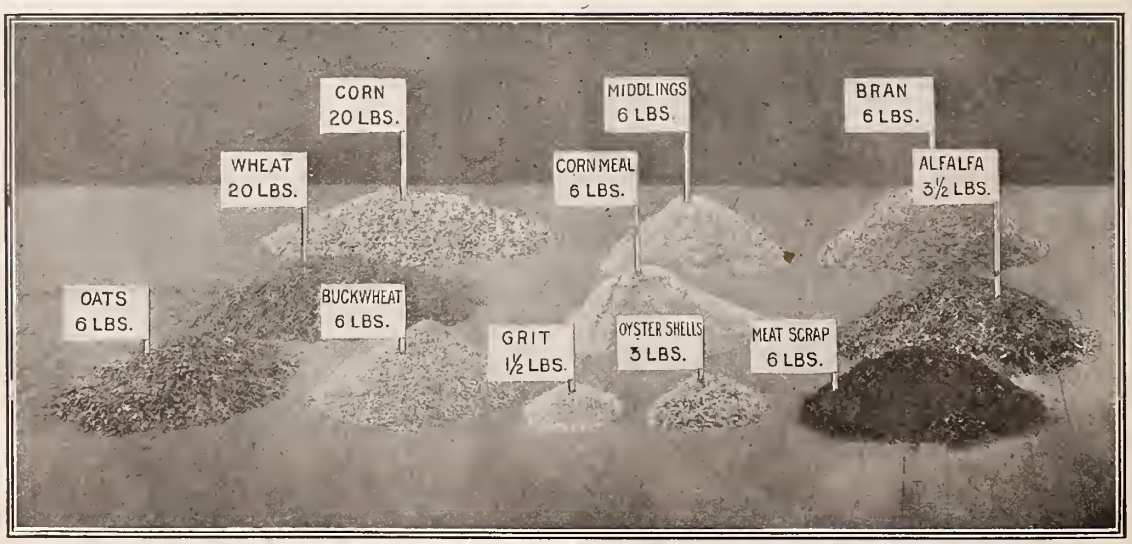
Scratch Mixture:

Winter—2 parts cracked corn, 1 part wheat, 1 part oats. Summer—1 part cracked corn, 1 part wheat, 1 part oats.

Dry Mash:

Wheat bran	100 pounds
Wheat middlings or low grade flour	100 pounds
Ground oats	100 pounds
Corn meal	100 pounds
Meat scrap	100 pounds

Grain fed in litter morning and evening. Mash in hoppers before the birds all the time. In general the



A YEAR'S RATIONS FOR A HEAVY-LAYING LEGHORN HEN

amount of grain consumed is slightly in excess of the mash, but in periods of very heavy laying more mash is consumed.

Ration No. 5b—Ohio Agricultural College Ration

I—Regular ration for layers at Ohio University Poultry Plant.

Scratch Mixture:

Cracked corn 3 parts, wheat 2 parts, oats 1 part.

Dry Mash:

Corn meal	4 pounds
Wheat middlings	6 pounds
Wheat bran	4 pounds
Meat scrap	4 pounds
Oil meal	1 pound
Alfalfa meal	1 pound
Charcoal	½ pound
Salt	1 tablespoon

The grain is fed in litter, a light feed in the morning, a full feed in the evening. The mash is fed in hoppers which are open all the time or closed a part of the time as necessary to have the birds eat about one-half as much mash as grain. Green feed is given freely, and grit and shell supplied in hoppers.

II—Ohio Experiment Station Ration.

Scratch Mixture:

Cracked corn 4 parts, wheat 2 parts, oats 1 part.

Dry Mash:

Corn meal	3 pounds
Wheat bran	2 pounds
Wheat middlings	1 pound
Meat scrap	2 pounds

This is fed in the same manner as the preceding.

Ration No. 6b—Massachusetts Experiment Station Ration

Scratch Mixtures:

I—Cracked corn 2 parts, wheat 1 part.
II—Cracked corn 3 parts, wheat 2 parts.
III—Cracked corn 2 parts, wheat 1 part, oats 1 part.

Mashes:

I—Wheat bran	200 pounds
Wheat middlings	100 pounds
Corn meal	100 pounds
Ground alfalfa	100 pounds
Meat scrap	50 pounds
Linseed meal	50 pounds
Gluten meal	50 pounds
II—Wheat bran	100 pounds
Wheat middlings	100 pounds
Corn meal	100 pounds
Fine ground oats	100 pounds
Ground alfalfa	100 pounds
Meat scrap	100 pounds
III—Wheat bran	100 pounds
Wheat middlings	100 pounds
Corn meal	100 pounds
Ground oats	100 pounds
Gluten feed	100 pounds
Linseed meal	100 pounds
Meat scrap	100 pounds

Any desired combination of the different scratch mixtures and mashes may be made. The method of feeding is to keep dry mash before the hens all the time, and give a light wet mash of the same ingredients about 2 p. m. In the morning, sometime between 6 and 9 o'clock, according to convenience, a light feed of the scratch mixture is given in litter. From 3:30 to 5 o'clock in the afternoon, according to the time of year, a full feed of the scratch mixture is given. Mangels and cabbage are fed freely, and shell and grit kept before the hens.

Ration No. 7b—Maine Experiment Station Ration for Pullets

Grain:

Morning—4 quarts cracked corn in litter 6 to 8 inches deep to 100 hens; 10 o'clock, 2 quarts wheat, and 2 quarts oats to each 100 hens.

Dry Mash:

First month in the laying house (September).

Bran	300 pounds
Corn meal	100 pounds
Low grade flour	100 pounds
Meat scrap	100 pounds

Second month in laying house.

Bran	200 pounds
Corn meal	100 pounds
Low grade flour	100 pounds
Gluten meal	100 pounds
Meat scrap	100 pounds

Third month—same as the second with the addition of 50 pounds of linseed meal.

Fourth month—same as the second month given above.

Fifth month—same as third month as given above.

From this time on 50 pounds of linseed meal is put into the mash each alternate month. The advantages believed to result from this method of varying the mash are, better vitality and more even egg production. When the birds are not on range sprouted oats are used freely for green feed. Grit and oyster shell are always provided.

Ration No. 8b—Wisconsin Experiment Station Ration

I—Feed in deep litter, a mixture of grains in the proportion of 4 pounds cracked corn to 1 pound each of oats and barley. Give this twice a day—a light feed in the morning feed in the morning and a full feed at night.

Feed in hopper (all the time) a mash mixture at the rate of 100 pounds each of bran, middlings, ground corn, and gluten feed, 50 pounds of meat scrap, and 2 pounds of salt.

Feed in trough (three times a week) same mixture of ground feed moistened with milk.

For green feed give sprouted oats and mangels. Give grit, oyster shell, charcoal, and water.

II—Feed in deep litter, scratch mixture in the proportions of 4 pounds of cracked corn to 1 pound of barley. Feed light in the morning and heavy at night.

Feed in hopper (all the time) mash of equal parts bran, middlings, and corn meal, salted slightly. Green feed and accessories as above.

Ration No. 9b—Minnesota Experiment Station Ration

I—Scratch Mixture:

Cracked corn 2 parts, wheat 2 parts, oats 1 part.

Mash:

Bran	100 pounds
Middlings	100 pounds
Corn meal	100 pounds
Green cut bone	100 pounds
Pea meal	50 pounds

Give all the scratch feed they will eat the first thing in the morning. About 11 o'clock give the mash, moist but not sloppy. After eating this they should have all the green feed they will eat. About two hours before dark, feed grain, same as in the morning. Keep water, grit, and ground oyster shell always before them.

II—Scratch Mixture:

Equal parts by weight, of cracked corn, wheat, and oats. (When corn is difficult to obtain barley is substituted for it).

Mash:

Equal parts by weight, of finely ground corn, oats, bran and shorts. Meat feed is supplied either by adding about 10 per cent meat scrap to the mash or by giving the hens all the milk they will drink.

The grain mixture is given twice a day, in litter, at the rate of about 7 pounds to each 100 hens in the morning, and about 8 pounds in the evening. The mash may be given either dry or moist. When fed dry it is kept before the birds in hoppers. When fed moist it is given about noon, wet with either water or milk, and sometimes with steeped clover leaves added. For green feed when the birds are confined to the houses about ten pounds of mangels a day are allowed to each 100 hens, or a bunch of clover hay tied, and suspended by a string is furnished from which the hens eat as they wish. Water, grit, and shell are provided.

Ration No. 10b—Purdue Experiment Station Ration

I—Scratch Mixture: Cracked corn 2 parts, wheat 2 parts, oats 1 part.

Mash:

Bran	5 pounds
Shorts	5 pounds
Meat scrap	3½ pounds

Grain scattered in deep straw litter in the morning and evening, about one-third as much in the morning as in the afternoon. Dry mash in hopper always open. Water, grit, and shell were always accessible.

II—Instead of the meat scraps in the above ration give all the milk the birds will drink. In winter increase the corn by 1 part, and reduce the wheat the same amount.

III—Instead of meat scraps in ration use about the same proportion—more rather than less—of fish scraps.

Ration No. 11b—Oklahoma Experiment Station Ration

I—Scratch Mixture: Cracked corn 3 parts, wheat 3 parts, oats 1 part.

Mash:

Mill run (bran and middlings)	7 pounds
Corn meal	7 pounds
Meat scrap	3 pounds
Alfalfa leaves	2 pounds
Charcoal	½ pound

Give the scratch mixture in litter twice daily, and keep the dry mash always before the birds in hoppers. Feed sprouted oats, cabbage, mangels or steamed alfalfa for green feed, and keep the birds supplied with shell, grit, and water.

II—Same as above but scratch mixture equal parts cracked corn and kafir corn.

III—Scratch Mixture: Equal parts of wheat and kafir corn.

Mash:

Mill run	7 pounds
Corn chop	10 pounds
Meat scrap	2 pounds
Bone meal	1 pound

IV—Same as III, but

Mash:

Mill run	8 pounds
Corn chop	7 pounds
Cottonseed meal	3 pounds
Bone meal	1 pound

Ration No. 12b—Missouri University Ration

I—Scratch Mixture: In winter, 2 parts cracked corn, 1 part wheat; in summer, 1 part cracked corn, 2 parts wheat.

Mash—Equal parts by weight, of bran, middlings, corn meal, and meat scrap.

II—Scratch Mixture: In winter, wheat 6 parts, cracked corn 3 parts, oats 3 parts, buckwheat 3 parts.

Mash:

Corn meal	6 parts
Middlings	6 parts
Bran	3 parts
Alfalfa meal	1 part
Oil meal	1 part
Meat scrap	5 parts

III—Scratch feed—Early morning and night, cracked corn; at noon, equal parts of wheat and oats.

Mash—Bran 3 parts, middlings 1 part, corn meal 1 part, meat scrap 1 part, occasionally add 1 part oil meal.

IV—Scratch mixture same as in I.

Mash—Ground oats, with buttermilk or sour milk as a drink.

V—Scratch Mixture:

Cracked corn	6 parts
Wheat	6 parts
Oats	4 parts
Barley	2 parts
Kafir corn	1 part
Buckwheat	1 part

Mash:

Bran	2 parts
Corn meal	1 part
Gluten meal	1 part
Ground oats	1 part
Ground oats	1 part
Middlings	1 part
Meat scrap	1 part

The method of feeding all these rations is the same—a light feed of the grain in the morning; the mash fed either in hoppers, or in troughs, at noon; a heavy feed of grain in the evening—green feed given frequently, and water, grit, and shell kept before the birds all the time.

Ration No. 13b—Manitoba Agricultural College Ration

Scratch mixture—wheat 2 parts, cracked corn 1 part.

Mash—crushed oats fed dry.

Give cabbage or mangels once a day, all the buttermilk the birds will drink, and keep water, shell, and grit always before them.

Ration No. 14b—Michigan Experiment Station Ration

Scratch mixture—Cracked corn, wheat, and oats, in proportions to suit the season, and the condition and appetite of the hens.

Mash:

Bran	100 pounds
Middlings	75 pounds
Corn meal	100 pounds
Beef scrap	100 pounds
Oil meal	25 pounds

If the mash is fed dry in hoppers, give a light feed of grain in the morning in litter; at noon open the hoppers and let the hens have mash at will until about 4 o'clock; then close the hoppers and give a good feed of grain in litter. Give plenty of green feed, shell, and grit, and keep water before the birds. If the mash is fed moist, give it at noon.

Ration No. 15b—North Carolina Experiment Station Ration

I—Scratch mixture—cracked corn 2 parts, wheat 1 part.

Mash:

Corn meal	4 parts
Bran	4 parts
Meat meal	2 parts
Bone meal	2 parts

II—Scratch mixture as in I.

Mash:

Corn meal	4 parts
Bran	4 parts
Cottonseed meal	4 parts
Bone meal	2 parts

In both rations the grain is fed twice a day in litter, and the mash is kept before the birds in hoppers. The hens have the run of yards in Bermuda grass throughout the winter, and occasionally a run on plots of oats and clover. They are kept supplied with water, shell, and grit.

Ration No. 16b—Montana Experiment Station Ration

Scratch mixture—Equal parts by measure, of wheat, oats, barley and peas.

Mash:

Wheat bran	10 pounds
Shorts	10 pounds
Ground oats	10 pounds
Ground barley	20 pounds
Meat scrap	10 pounds
Flax seed	10 pounds
Salt	26 ounces

The flax seed is given in alternate months only.

Ration No. 17b—Washington Agricultural College Ration

I—Scratch mixture—Equal parts by measure, of cracked corn, wheat and oats.

Mash—Equal parts by weight, of coarse bran, wheat middlings, ground oats, corn meal, and 10 per cent of meat scrap.

Give a fairly liberal feed of grain in litter in the morning, and a heavier feed toward evening; keep the mash before the fowls in hoppers. Give grass, kale, cabbage, etc., for green feed. Give both milk and water in separate vessels. Keep shell and grit before them.

II—Scratch Mixture:

Wheat	250 pounds
Clipped barley	100 pounds
Sunflower seed	35 pounds

Mash:

Bran	125 pounds
Middlings	90 pounds
Ground oats	100 pounds
Oil meal	25 pounds
Fish meal	50 pounds
Charcoal—flaked	1 bucket

The scratch mixture is fed in litter twice a day; the mash kept before the hens in hoppers. Green feed and accessories as in I. When corn is reasonable in price it is used in the scratch feed in preference to barley. (The rather unusual proportions in the mash in this case result from the fact that mill stuffs in the vicinity are not always put up in standard 100-pound bags).

Ration No. 18b—Oregon Agricultural College Ration

Scratch mixture—Oats 25 pounds, barley 10 pounds.

Mash:

Mill feed (bran and shorts)	5 pounds
Ground oats or barley	5 pounds
Ground corn	5 pounds
Linseed meal	5 pounds or

THREE SMALL POULTRY RANCHES INSIDE THE CITY LIMITS OF PETALUMA, CALIF.
Each one keeps 300 to 500 layers.

Cocoanut meal ..... 7 pounds
Meat or fish scrap ..... 7 pounds

The grain should be fed in litter. The mash may be given either dry or moist. If fed moist the amount of animal matter in it should be reduced and some meat or fish scrap fed in a hopper.

Ration No. 19b—California Experiment Station Ration

Scratch mixture—Whole or rolled barley 2 parts, Egyptian corn or milo maize 1 part, cracked corn 1 part.

Mash:

Wheat bran ..... 50 pounds
Middlings ..... 50 pounds
Ground barley or oats ..... 50 pounds
Soy bean or linseed meal ..... 10 pounds
Cocoanut or soy bean, or linseed or cottonseed meal, or ground beans ..... 10 pounds
Meat scrap or fish scrap ..... 30 pounds
Fine granulated charcoal ..... 5 pounds
Fine salt ..... 1 pound

The mash may be fed either dry or moist. Wheat may be used in the scratch mixture in moderate quantity to replace all or a part of any one of the other grains. If sour milk or buttermilk can be kept constantly before the hens, no meat scrap need be fed. Fresh raw ground bone may also be substituted for meat scrap if fed at the rate of a half an ounce a day.

Ration No. 20b—Kansas Experiment Station Ration

Scratch mixture—Wheat 2 parts, cracked corn 2 parts, oats 1 part.

Mash:

Shorts ..... 6 pounds
Bran ..... 3 pounds
Corn meal ..... 6 pounds
Meat scrap ..... 5 pounds
Alfalfa meal ..... 1 pound

Give green feed liberally, and substitute milk for meat scrap whenever a supply of it is available.

Kafir corn and buckwheat may be included in the grain mixture, or substituted for some of the other ingredients. Other meals, such as linseed meal, pea meal, soy bean meal, and cottonseed meal may be added to the mash in small quantities.

Ration No. 27b—Maryland Experiment Station Ration

Scratch mixture—Equal parts of cracked corn, wheat, and oats.

Mash:

Bran ..... 100 pounds
Middlings ..... 50 pounds
Corn meal ..... 50 pounds
Linseed meal ..... 50 pounds
Meat scrap ..... 50 pounds
Charcoal ..... 2 pounds
Salt ..... 2 pounds

To a pen of 40 hens two quarts of the grain mixture is given early in the morning. Between 8 and 9 o'clock from 3 to 5 pounds of cabbage. At noon the same amount of grain as in the morning. The dry mash is accessible to the birds at all times. Fresh water, shell, and grit are kept by them.

Ration No. 28b—Kentucky Agricultural College Ration

Grain Mixtures:

	Pounds		Quarts
I—Cracked corn	50	or	30
Heavy oats	20	or	20
Barley	20	or	13¼
Wheat	10	or	5¼
II—Cracked corn	70	or	42
Heavy oats	30	or	30
III—Cracked corn.			

Dry Mashes:

I—Ship stuff	40	or	60½
Corn meal	20	or	18
Ground oats	20	or	46½
Meat scraps	20	or	11
II—Ship stuff	50	or	75½
Corn meal	30	or	27
Meat scrap	20	or	11
III—Corn meal	40	or	36
Meat scrap	25	or	13¾
Ground oats	20	or	46½
Alfalfa meal	15	or	27

Any one of the grain mixtures may be fed with any of the mashes. The grain should be scattered in litter, about one-third of the total amount fed in the morning and two-thirds in the evening. The dry mash should be kept before the birds all the time. Green feed should be fed to all hens during the winter, and in the summer to birds in confinement. Water, shell, grit, and charcoal should be kept before the birds all the time.

Ration No. 29b—West Virginia Experiment Station Ration

Scratch Feed:

Cracked corn ..... 60 pounds
Wheat ..... 60 pounds
Oats ..... 40 pounds
Barley ..... 20 pounds
Buckwheat ..... 10 pounds

Mash:

Wheat bran ..... 200 pounds
Corn meal ..... 100 pounds
Ground oats ..... 100 pounds
Gluten feed ..... 100 pounds
Wheat middlings ..... 100 pounds
Meat scrap ..... 100 pounds

The grain is fed in litter twice a day. The mash may be fed either wet or dry. Cabbage, mangels, sprouted oats, cut alfalfa, and beet pulp may be used for succulent feed. Grit and shell are provided.

Ration No. 30b—Louisiana Agricultural College Ration

Scratch grain: Summer—Morning, oats: night, oats 3 parts, cracked corn 1 part. Winter—Morning, cracked corn 1 part, oats 2 parts; night, corn.

Mash:

Corn meal ..... 30 pounds
Wheat bran ..... 30 pounds
Cottonseed meal ..... 15 pounds

Keep the mash before the birds at all times. Give other grains occasionally as available to add variety. Give succulent green feed and provide grit and shell.

Ration No. 31b—Texas Experiment Station Ration

Scratch mixture—A variety of grains, principally cracked corn, supplemented with milo, wheat, oats, etc. Or, milo may be used as the sole or principal grain. The mash given is especially for use with milo.

Mash:

I—Wheat bran ..... 70 pounds
Wheat shorts ..... 50 pounds
Cottonseed meal ..... 60 pounds
Milo meal ..... 20 pounds

II—Wheat bran ..... 50 pounds
Wheat shorts ..... 60 pounds
Cottonseed meal ..... 30 pounds
Meat scrap ..... 22.5 pounds
Milo meal ..... 20 pounds

The grains are fed as a scratch feed in litter, a light feed in the morning and a full feed in the evening. The mash is fed in hoppers which are opened at noon and left open until the grain is fed in the evening. Green feed is supplied plentifully, and water and some kind of shell-forming material are kept before the birds all the time.

Ration No. 32b—New Hampshire Agricultural College Ration

Scratch Mixture:

Cracked corn ..... 6 parts
Oats ..... 6 parts
Buckwheat ..... 4 parts
Rye ..... 5 parts

Mash:

Corn meal ..... 100 pounds
Bran ..... 100 pounds
White middlings ..... 100 pounds
Ground oats ..... 100 pounds
Cut clover ..... 100 pounds
Meat scrap ..... 50 pounds

The grain is fed three times a day in deep litter. In the coldest winter months the quantity of corn is doubled. If rye and buckwheat are not available, wheat screenings are used in their place. The dry mash is kept always before the hens. It is varied occasionally by the addition of one part of pea meal, barley meal, or rye meal. Cabbage, mangels, turnips, and sprouted oats are used for succulence.

Ration No. 33b—Macdonald Agricultural College Ration

Scratch mixture—In winter, 2 parts cracked corn, 2 parts wheat, 1 part oats or buckwheat. In summer use less corn.

Mash:

Wheat bran ..... 200 pounds
Crushed oats ..... 120 pounds
Corn meal ..... 100 pounds
Middlings ..... 100 pounds
Meat scraps ..... 60 pounds
Charcoal ..... 20 pounds

The grain is fed in litter morning and evening. The mash is fed at noon in troughs, having been moistened with milk or water. The mash may be fed dry in hoppers, if desired. Cabbage, mangels, turnips, and sprouted oats are used for green feed. Water, grit, and shell are kept before the hens all the time. Milk is given when available.

Ration No. 34b—Storrs, Connecticut, Laying Contest Ration

I—Ration Used in Earlier Contests.

Scratch Mixture:

Cracked corn ..... 60 pounds
Wheat ..... 60 pounds
Heavy white oats ..... 40 pounds
Barley ..... 20 pounds
Kafir corn ..... 10 pounds
Buckwheat ..... 10 pounds

Dry Mash:

Coarse wheat bran ..... 200 pounds
Corn meal ..... 100 pounds
Gluten feed ..... 100 pounds
Ground oats ..... 100 pounds
Standard middlings ..... 75 pounds
Fish scrap ..... 45 pounds
Meat scrap ..... 45 pounds
Low grade flour ..... 25 pounds

II—Ration Used in Recent Contests:

Scratch mixture—Equal parts of wheat and cracked corn.

Mash:

Wheat bran	100 pounds
Corn meal	100 pounds
Ground oats	100 pounds
Flour middlings	100 pounds
Fish scrap	50 pounds
Meat scrap	50 pounds

The grain is fed two or more times a day in litter, as seems necessary to keep the hens busy. The mash is fed dry, the hens having access to it at all times. The principal succulent feed in winter is mangels. In summer the yards furnish green feed. Grit, shell, charcoal, and water are always accessible.

Ration No. 35b—Delaware Agricultural College Contest Ration

Same as No. 34b-I, except that 15 pounds less each of fish scrap and meat scrap are put in the dry mash, and 10 pounds of coarse meat scrap is added to the scratch feed formula.

Ration No. 36b—Missouri State Experiment Station Contest Ration

Scratch mixture—In spring and fall, equal parts of corn and wheat; in winter, 2 parts cracked corn and 1 part wheat; in summer, 1 part cracked corn, and 2 parts wheat.

Dry mash—Ground oats, to which has been added 10% of meat scrap, and a little charcoal and salt. When ground oats are not available, the mash is of equal parts bran, middlings, and corn meal, with the other ingredients added as to the oats.

The mash is kept before the hens all the time. The grain is fed as follows: Each morning 1 pint to ten hens, and at night a pint and a half to ten hens. Green feed is provided, also grit and shell, and fresh water are always accessible.

Ration 37b—British Columbia Laying Contest Ration

Scratch mixture—Winter, equal parts wheat and cracked corn; summer, wheat 3 parts, cracked corn 1 part.

Mash:

Ground oats	42 pounds
Shorts	22 pounds
White middlings	20 pounds
Meat scrap	15 pounds
Charcoal	1 pound

The dry mash is kept before the hens all the time; on three mornings a week a wet mash of the same ingredients is fed, the birds being given only what they will clean up quickly. On the other four mornings grain is fed in litter. At noon green feed is given. In the evening grain in litter.

Ration No. 38b—Cornell Heavy Laying Ration

Scratch Mixture:

Winter	Weight	Measure
Wheat	60 pounds	32 quarts
Cracked corn	60 pounds	36 quarts
Oats	30 pounds	30 quarts
Buckwheat	30 pounds	20 quarts
Summer:		
Wheat	60 pounds	32 quarts
Cracked corn	60 pounds	36 quarts
Oats	30 pounds	30 quarts
Mash:		
Corn meal	60 pounds	57 quarts
Wheat middlings	60 pounds	71 quarts
Wheat bran	30 pounds	57 quarts
Alfalfa meal	10 pounds	20 quarts
Oil meal	10 pounds	8 quarts
Meat scrap	50 pounds	43 quarts
Salt	1 pound	½ quart

The hens should eat about half as much mash, by weight, as grain. Regulate the proportion by giving a light feed of grain in the morning, and at the afternoon feeding all they will consume before dark. The grain is supplemented with green feed, grit, and shell, and the birds always supplied with fresh water.

SELECTED RATIONS REPORTED BY POULTRYMEN IN THE NINETIES, TAKEN FROM POULTRY-CRAFT (1899)

Ration No. 39b—E. C. Wyckoff's Ration: Morning—Mash compounded as follows: 1 bu. corn, 2 bu. oats, ground fine; to each 200 pounds of this mixture add 100 lbs. of bran and 5 or 6 lbs. of beef scraps; moisten with milk; feed in troughs, returning after ten or fifteen minutes to take up any feed that may be left, and give more when needed. At noon—green feed, mangels, cabbage in winter; clover or kale in summer; sometimes a light feed of mixed grain in litter. Night feed—mixed grain. In winter, 2 bu. each wheat, oats, buckwheat, and corn; in summer, the corn in the mixture reduced one-half.

Ration No. 40b—F. H. Dawley's Ration: Morning—mash, clover hay or crimson clover steamed overnight; in the morning stirred up with a mixed feed of 100 lbs. coarse wheat bran, 75 lbs. yellow corn meal, 100 lbs. ground oats, 50 to 75 lbs. linseed meal, a little charcoal and salt. Feed all they will eat clean. Noon—green bone and vegetables. Night—whole wheat, and a little corn.

Ration No. 41b—J. H. Robinson's Ration: Morning—mash—by measure, 2 parts finely cut alfalfa, 2 parts heavy bran (bran and middlings), 1 part corn meal, made into a stiff, almost crumbly dough by scalding with water or sweet skim milk. Feed either hot or cold, all the hens will eat in ten or fifteen minutes. If other green feed is abundant the hay may be omitted. Noon—a light feed of oats or millet, either dry or steamed, or of wheat—about one-half pint to ten hens. Evening—wheat, about one pint to ten hens, in litter, followed just at dusk with whole corn to fowls that are waiting for it. Two or three times a week, green cut bone at mid-afternoon, and on these days the evening feed slightly reduced.

These three rations are typical rations of the period before educational institutions began to develop exact formulas for mashes and the mixtures or combinations of grains used by practical poultrymen.

As has been stated, the number of poultry keepers who could give accurate statements of their method of feeding was small, but there were always a few who could do so. Most practical poultrymen, who are concerned only to get results from their feeding, and have really no interest in describing their method for others, have always been reluctant to state either exact proportions in the feeds, or exact amounts fed, because of the extent to which, in their practice, they vary from their general standard to suit conditions. Educators also appreciate the difficulties of making definite statements for changing and variable conditions, but nevertheless have to be as definite as possible, giving the best standard they can, and trusting to the common sense of the novice to make desirable modifications in rations as experience demonstrates the occasions for doing so.

Some Practical Points About Methods of Feeding

To a great extent the rations used and recommended by government departments and institutions dealing with poultry production, represent the practice of poultry keepers in the localities of the various institutions and departments. Those engaged in educational work generally take the practice of the best poultry keepers they know as the basis of their own methods. They frequently are able, as the result of more accurate observations than can be made in common practice, to make and suggest modifications which increase the efficiency of rations. Their recommendations lead to the more extensive use of rations that are giving good results, and tend to standardize feeding practice among their constituents. Equally with regard to rations used and recommended by poultry departments in the public service, and rations used and recommended by successful poultry keepers,—whether those are of their own compounding or are commercial mixtures—it may be assumed that the rations are efficient rations, when properly used.

The list that has been given, while very comprehensive, is by no means an exhaustive one. As it is, however, it shows plainly that the exact proportions of different feed elements in rations are not the prime factors in determining their feeding value, and that within tolerably wide limits differences in proportions of ingredients have no particular bearing on the efficiency of the ration. The essential thing is to supply the fowls with liberal rations, containing the general proportions appropriate to the climatic and other conditions affecting appetite and results, and to do this under conditions that promote regularity in eating, a reasonable amount of exercise, and normal habits. This being done, further balancing of the ration given to a flock is a matter of each individual taking feed according to its taste and appetite. The fact is that, given a sufficient supply of grains in simple variety—partly hard, and partly in the form of meal, with animal feed in sufficient amount to furnish protein that may be required over and above what the grains supply, the real regulator in the ration is the supply of green feed.

Many poultry keepers who use commercial mixtures and find them very satisfactory are anxious to get the formulas for them, either that they may make near sub-

stitutes when unable to secure a supply, or in the expectation that they may be able to duplicate the mixture at less cost by buying the ingredients separately and mixing them themselves. Many manufacturers of feeds now publish in their literature, in their advertisements, and sometimes on packages containing their products statements of the kinds of ingredients in them, and of the percentages of fat, protein, and fiber which they guarantee. They do not give proportions of the different ingredients, for the simple reason that secrecy as to such details of trade formulas and processes is the manufacturer's protection for the reputation he may be able to build up for a particular line or brand of goods. Regardless of whether the article is equal, or superior, or inferior, to some other of its class, or whether the manufacturer's claims for it are moderate or extravagant, when goods of this character make a reputation under a certain name or brand, the proprietor acquires an exclusive right to the use of that name or brand, as well as to a trade-mark, and exclusive knowledge of his formula is on the same principle as the right of an inventor, or the copyright of an author.

The real merits of commercial mixtures and brands of live stock and poultry feeds are not in the peculiar individual properties of certain articles or lines of goods, but in the good features common to all lines put out by reputable houses seeking to build up a large demand for their goods. The manufacturer of poultry feeds has superior advantages in buying the ingredients for them. Operating on the scale that he does he can make all tests necessary to determine the exact values of ingredients as used, and so he can, whenever there is occasion to do so, make the variations in his mixtures necessary to maintain his nutritive standards. Without disparagement of any line of products it may be said that the well-known popular lines are equally good, and looking over the formulas as recommended by many experiment stations the reader can easily judge for himself that many brands are equally well adapted to supply the grain ration for poultry anywhere. The ordinary variations in other than commercial rations are made as a rule to utilize the most available and the cheapest feeds. Costs of feeds vary much more with locality than do the feed requirements of poultry.

When a certain feed or ration is giving good results, it is good policy to continue its use unless one is certain that better production or lower cost will follow a change; but no poultry keeper ought ever to allow himself to harbor the idea that any formula—whether used at a laying contest or recommended by an uncommonly successful breeder, or by an experiment station—is so superior to others that equally good results cannot be obtained from some other ration. When a familiar and favorite feed, whether a commercial or a home mixture, cannot be obtained, the only sensible thing to do is to take whatever commercial feed is available, or to make as good a combination as possible of available ingredients. The last thing that should be considered (which, however, is the first thing that a great many people do) is to feed short on the favorite usual ration with the idea of making the supply last as long as possible when it is running low and the prospect of replenishing it at an early date is doubtful, or to feed light of a new ration or feed—on the theory that if the ration is not as good as that commonly used, the less fed of it the better. Novices are especially prone to take this attitude when the feeding of a different ration from that which has been used starts mild digestive trouble and perhaps leads to more serious results in a few cases. They suppose that the new feed, or something in it, is in itself harmful, when the fact is simply that the birds have been so managed that they are easily affected by changes of diet.

There is nothing in itself harmful in any article commonly used for poultry feed. Some things are dangerous when fed to excess, but poultry do not usually take such things in excessive amounts unless practically forced to do so in order to get an amount of feed that will barely satisfy their hunger. With the exception of those who have had wide experience in the use of feeds, and with different classes and types of fowls, nearly all poultry keepers have more or less trouble when they make any radical change in a ration, but when the change is a necessary one, the only sound policy is to make whatever other adjustments of the ration the primary change makes necessary, and then feed well, culling out as soon as possible any individuals that it appears will not thrive on the new diet.

COLONY HOUSES IN SMALL YARDS ON A NEW ENGLAND DAIRY AND POULTRY AND GARDEN FARM

The land in use for poultry at any time is stocked to its intensive capacity, but the poultry goes on fresh land each year. There is a road between the two rows of houses and the yards extend from it on either side.

One of the most important points in feeding for egg production is to have already established good habits of feeding in the pullets, and to preserve these throughout the productive life of the hens. A common caution in regard to the use of mashes, both moist and dry—but moist mashes in particular—is to avoid overfeeding the fowls, because overeating of mash (it is alleged) makes fowls sluggish and inactive, so that after eating heartily of mash they become almost torpid for hours, standing listlessly about when they ought to be scratching for grain. While this is a common case, it is not a necessary and inevitable consequence of full feeding of any mash; but rather is the result of feeding poorly made and somewhat indigestible mashes, or mashes too

rich in concentrated materials, or may be simply because the birds have been allowed to get into bad eating habits. If birds after eating liberally of a moist mash act as described, the keeper should either find out how to feed moist mash without causing the fowls to do this, or change to a dry mash.

It is entirely possible to give hens, as soon as they will eat in the morning, a liberal feed of moist mash—all they will eat at once—and then have them go directly to scratching for grain in litter, although there is more mash still in the troughs uneaten. In fact it is the nature of the normal healthy bird to do it—to take a variety of things at one meal, just as a normal human being does. In feeding thrifty young chickens to make the best possible growth it is found that after giving them all they will eat of either soft or hard feed, they can be given the other form and will eat a substantial quantity of it, on top of what appeared to be a full meal. As they complete their growth they are less inclined to do this, for their feed requirements are less and their appetites not so keen; but if they have always been accustomed to find grain by looking or scratching for it, and if the mash when taken into the crop does not distress them, they will very soon, and often immediately after eating what mash they want at one time, begin to forage or scratch for grain. If the birds know that there is no grain to be had until the feeder gives a new supply some hours later, it is not to be expected that they will look for grain after filling up pretty well on other feed. If they have learned by experience that what they eat while the mash is before them is all they will get until the next feeding time, it is not to be expected that they will be prevented from taking mash to the limit of their capacity by anything but shortage of the supply or positive distress from having eaten too much of it. Fowls are not of a high order of intelligence, but all animals instinctively try to secure their full share of supplies of feed in sight when there is nothing else immediately in prospect.

In good practice, with the dry-mash method of feeding, the mash is usually accessible to the birds either all the time or for long periods daily, and when the mash is not accessible the scratch feed is. It can hardly be repeated too often, or emphasized too strongly, that the greatest value in the dry-feeding method, is in keeping feed of some kind always before the birds. If this rule is adopted with a moist-mash system, it will be found that unless the mash made and fed is very bad indeed, or the birds have indigestion to start with, the common bad effects accompanying moist-mash feeding will be conspicuously absent. A poultry keeper who wishes to use moist mashes regularly and freely, and to be sure that the mash made is a thoroughly good one—right in consistency and bulk—can best get at the heart of the matter by feeding the mash in the morning, experimenting intelligently both with composition and mixing of the mash and with the quantity to be given, until he can make a mash that the birds will eat freely, but not gluttonously, and still show some interest in any other kind of food that may be availible.

Feeding in the morning is the best test of the mash itself, because when it is fed at noon the birds usually have in their crops some grain or other feed which helps relieve any bad effects of an unsuitable mash, and also tends greatly to reduce the amount of an unsuitable and perhaps unappetizing mash consumed. Feeding mash at night gives no opportunity at all to judge of its possible tendency to make the birds inactive because they go to roost then anyway. The old theory of the morning mash was that the birds having had a long fast, especially in the long winter night, should have soft feed first because it would be more quickly digested and assimilated. On the same line of reasoning the night feed was of hard grain—with whole corn much favored—with the idea that it took longer to digest and that the birds were more comfortable—were really being nourished—while the feed was in the digestive tract. These ideas seemed convincingly reasonable to the majority of poultry keepers in those days, but no data were ever obtained that would support any theory of the kind.

In general, the feeding of a soft mash to adult birds more than once a day is not good practice, nor is it wise to force heavy consumption of dry mash by giving the hens less grain than they will eat if allowed to select for themselves, unless the idea is to force egg production as long as the hens will stand that kind of feeding, and kill them for the table as soon as they show symptoms of being unfavorably affected by it. Too much feeding of soft mash, with a corresponding reduction in the amount of hard grain given, not only weakens the digestive organs, but causes more or less relaxation of the whole muscular system. When this is accompanied, as it often is, by increased egg production as the result of forcing feeds, many hens are unable to retain their eggs in the oviduct until complete, and lay soft-shelled eggs although liberally supplied with shell-forming material. The best way to correct such conditions is to give a diet of all hard grain and vegetable feeds, letting the bird balance its own ration of these, and feeding no meat or other especially stimulating feed until it is again in normal condition.

It will be observed that nearly all the directions for feeding given say that the grain is fed in litter. Obviously this is done in the houses in most cases, both winter and summer. Wherever layers can be kept on range in summer, it is much better to broadcast the grain on the range, thus giving the hens every inducement to forage widely. It is especially desirable to do this with the heavier breeds, and hens of any breed that have a tendency to put on fat. Some judgment must of course be exercised in the matter of feeding grain outdoors in wet weather. It should not be fed outside in protracted heavy rains when the birds will not stay out long enough to get a feed. A little experience will enable the poultry keeper to judge how much rain it takes to discourage his hens from foraging for their feed. Also in putting out grain in wet weather he should be careful not to put out more cracked corn than will be eaten before the next feeding time, for cracked corn lying out in the wet or in alternate wet and heat deteriorates very quickly. With whole grains there is no loss, for wetting soaks and sprouts them, so that there will be no waste and no harm done if oats, barley, wheat, and rye are thrown out more freely than usual in damp weather. The birds can get what they want more quickly, and will soon clean up any excess after the wet weather is over.

For some years the most common practice has been to feed the hard grain in a mixture, giving the different kinds in the same proportion at every feed. This practice has come in largely as the result of the necessity for using commercial mixtures to get the desired variety in grains, and because so large a proportion of poultry keepers, buying feed in small quantities, preferred to buy mixtures rather than various and sometimes small amounts of different kinds of grains. While grains were easily obtained in fair variety the common practice of good poultry keepers was to feed the grains separately.

and many poultry keepers still follow it. It is the method that is best adapted to feeding when the stock consists of more than one breed, the different breeds requiring somewhat different rations, and when the stock contains lots of birds that are being fed for different purposes, or when the stock is divided into flocks of the same variety requiring somewhat different treatment. It tends to prevent hens from picking a favorite grain first, as they are inclined to do when mixed grains are fed. While a hen that perhaps is averse to eating oats, and especially fond of corn, might eat rather sparingly of a feed of oats at noon, and eat greedily of the feed of cracked corn in the evening, she cannot take the corn and leave the oats to the extent that she would if they were always given at the same time.

When the grains are fed separately it is a simple matter to give hens that need a larger proportion of oats a heavy feed of oats, and when the corn is fed give them a light feed of corn. Or, whatever grain is fed, those hens which should have more than average proportions of it can be given them at the time it is fed, and fed lighter of some other meal—either mash or hard grain, or both, as circumstances require. While it is usual to feed the mixed grains rather lightly at morning or noon, and heavier at the evening feeds, in deep litter feeding there ought always to be some grain in the litter, and it does not make much difference what time of day it is put there.

Varying the amount of grain as just described, and providing conditions especially suited to them are the practical ways of getting good egg yields from hens of the breeds and types that do not lay well under ordinary conditions and handling. Large fowls, and all fowls with a tendency to fatten easily should have either good range or deep litter that does not pack too quickly, and is light and easily worked. The specification for deep litter in the laying houses is often "more honored in the breach than in the observance", not because the poultry keeper does not intend to keep the litter in the condition that it should be, but because many things may interfere with renewing it at the appropriate time, and not infrequently supplies of litter are hard to obtain. With small active fowls it does not make so much difference. In fact, if they go into winter quarters in good condition and start laying seasonably they may lay as well for three or four months fed in troughs or on bare floors and taking comparatively little exercise, as when fed in litter, but they will not keep in as good physical condition, and toward spring will develop a much larger proportion of cases of liver trouble than flocks that have had a reasonable amount of exercise in getting their daily ration.

With large hens and those having a strong tendency to fatten, good egg production through a long period calls for careful management to keep the hen always in laying condition. There is a common impression that pullets often fail to lay at maturity because they are allowed to become too fat. This idea is responsible for a great deal of short feeding of pullets at the very time when they should be fed most liberally, for while a pullet may not be increasing in size and weight in the few weeks between the first indications of laying and the beginning of egg production when development is regular and normal, she is growing a coat of feathers and the reproductive organs are developing, and for these things she can usually use to advantage all the feeds she can digest and assimilate.

It is doubtful whether becoming too fat as she approached maturity was ever the first and true cause of a pullet's failure to lay. When pullets are handled under conditions that give the keeper opportunities to observe them closely, and to give attention to feeding them to put them in ideal condition for egg production, it will often develop that the pullet either will not lay at all, or will lay little and irregularly and probably lay abnormal eggs. This furnishes reasonable grounds for supposing that the real reason she puts on fat is because the reproductive system does not function properly and, the digestive organs being good and the pullet eating well, the feed that would go to eggs if the reproductive organs were normal naturally goes to fat. This may also be the case when moving a pullet about to begin laying checks egg production. The ovary, sensitive to the

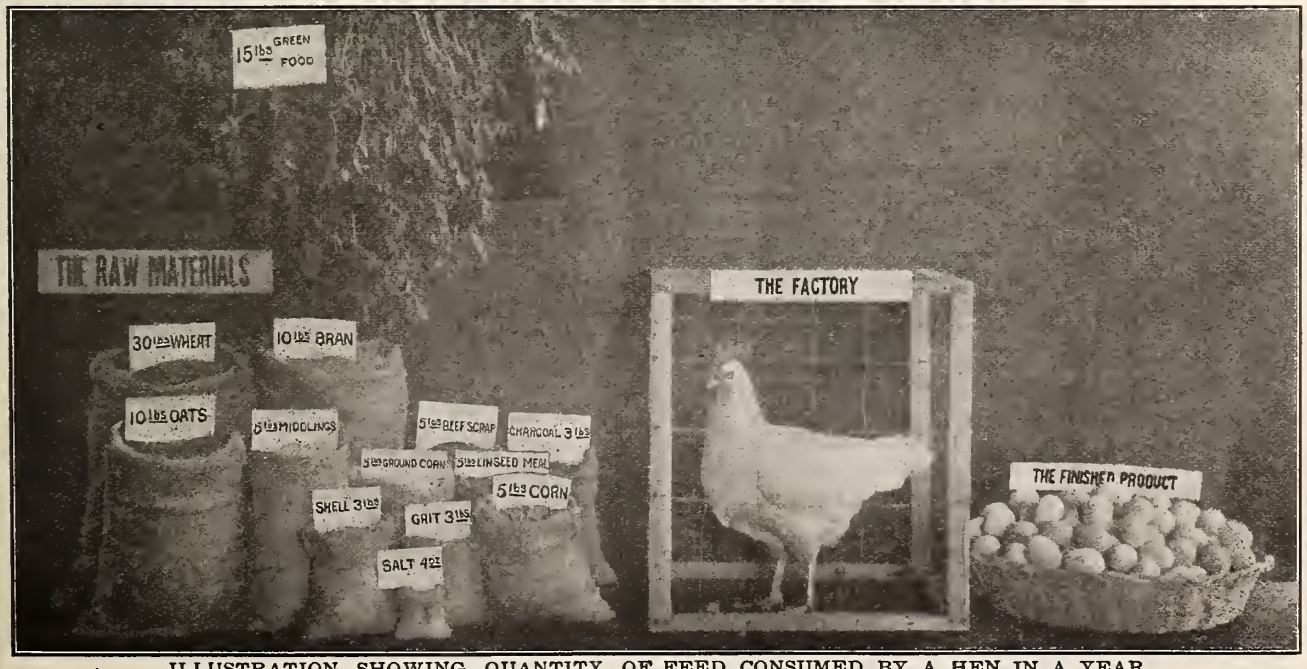


ILLUSTRATION SHOWING QUANTITY OF FEED CONSUMED BY A HEN IN A YEAR

This display was arranged by Prof. James Dryden for a part of the space allotted to poultry in an agricultural "Demonstration Train" traveling in the State of Oregon.

change, becomes dormant—the more readily because fall laying is in a measure abnormal—the pullet becomes fat, and it is supposed that she does not lay because she is too fat. Removing the fat, however, is not at all sure to start the pullet laying before the approach of the natural spring laying season, while when that comes—unless there is something wrong with the ovary, she will begin laying even though very fat.

Where the seat of trouble is concealed, and the causes are more or less obscure, as in most cases when eggs are not produced according to expectation, the best course is to try to adjust the feed and the conditions of feeding to keep the bird in good flesh, a little fat, but not overfat, and keep it active and lively, and await developments. While we may say that the accumulation of fat does not act as a direct preventive of egg production, there is no doubt that the accumulation of fat beyond the moderate reserve that is advantageous to the bird impairs its vitality and weakens every function. It is continued and progressive general physical deterioration, and not the mechanical interference of fat, that unfits overfat hens for egg production, and is likely to limit their laying period to a short term in the spring.

When we come to consider the details of fattening poultry, it will be shown that feeding to fatten quickly spoils the digestion. When stock fattens on laying rations, under the conditions appropriate for laying stock, the same thing takes place, but at a much slower rate. The effect of impaired digestion, and the general physical deterioration that goes with it, is not to make a non-layer, but to make the reproductive processes as slow as all the other processes of the life of the bird. It is customary to speak of extra-good layers as high producers and of poor layers as low producers. The terms, fast producers and slow producers, would be more significant of the relation of the hen to her product. The high producer lays eggs continuously and in quick succession; the low producer lays more or less intermittently—that is, she skips more days while laying most regularly, and she is apt to take frequent rests to recuperate from a strain of egg production which a more vigorous bird does not feel.

Amount of Feed Consumed By Laying Hens

As the amount of feed consumed by any flock varies more or less with conditions and according to the size and type of the fowls, hens cannot be fed "by the scales." Knowledge of what has been eaten by definite numbers of hens of a given breed and weight is, however, of considerable service to poultry keepers. It enables them to determine whether they are getting the results they should from the feeds they use, and when they cannot keep account of feed as used it helps them to make very accurate estimates. A number of the experiment stations have published valuable data of this kind. The figures that follow have been abstracted from their reports:

At the Ohio Experiment Station in 1911, in four flocks, each of about 50 White Leghorns, the average weight of the hens being 3.46 pounds, the average consumption of grain and mash was 69.3 pounds, of which 47.2 pounds was grain, and 22.1 pounds mash. Each pullet also consumed about 5 pounds of green feed, about 5 pounds of clover chaff, ¼ pound of grit, 1¾ pounds of shell, and ½ pound of bone.

In the following year records for four flocks of White Leghorns, with 75 to 80 in each, with an average weight little over 3 pounds, the average consumption of grain and mash was 65 pounds; while in a flock of Barred Plymouth Rocks, numbering about 150 and averaging to weigh 5.3 pounds, the average consumption of grain and mash was 80.64 pounds.

In 1913, records were kept for two flocks of about 100 each, the number varying slightly as a result of losses. They were kept, one in confinment, the other on a grass range containing about two acres. These were somewhat larger Leghorns than in the former experiments, weighing about 3¾ pounds each. The average consumption of grain and mash by the hens in confinement was 59.98 pounds, by the hens on range 61,24 pounds. The report of this experiment does not mention the feeding of green feed of any kind to the flock in confinement. The lack of green feed would account for the lessened consumption of grain. It would appear by comparison with the first case cited above, that the flock of 103 hens ranging through the summer on a two-acre pasture secured from it the equivalent of about 8 pounds of grain per bird, besides green feed.

Experiments at this station in subsequent years show very nearly the same consumption, 3-pound hens taking about 60 pounds of grain and mash a year, from 2 to 3 pounds of shell, and exceedingly variable amounts of grit, sometimes as low as 2 ounces, sometimes nearly a pound.

At Purdue Experiment Station the average consumption of White Plymouth Rock hens fed Ration No. 10b—I was 85.75 pounds of grain and mash, 8.53 pounds of meat scraps, .66 pound of grit, 2.09 pounds of shell, and .6 pound of bone—a total of 97.63 pounds. A similar pen fed Ration No. 10b—II consumed 81.25 pounds of grain and mash, 1.28 pounds of grit, 2.33 pounds of shell, 1.22 pounds of bone, and 115.74 pounds of milk per hen.

In a similar experiment with White Leghorns the consumption of grains ranged from 56 to 66 pounds per year, with meat consumed 4 to 5 pounds, and milk from 80 to 90 pounds a year. These reports do not show the weight of the birds.

The reports of the Storrs Laying Contest give the consumption of feed by all pens in these contests. From the report of the third contest, which has this data in the most convenient form, it appears that Plymouth Rocks, Wyandottes, and Rhode Island Reds, weighing 5½ to 6 pounds, consumed an average of a fraction over 88 pounds of grain and mash a year, with a few pens consuming over 100 pounds; and that Leghorns averaging about 3½ pounds consumed not quite 77 pounds of grain and mash a year.

In some early experiments with White Leghorns with rations of different kinds, at Cornell, the consumption of mash and grain ranged from 77.2 to 88.5 pounds per hen. The hens in these experiments were above the average size of Leghorns, many of them weighing over 4 pounds, which accounts for the larger consumption of feed than in the other cases of Leghorns mentioned.

The New Jersey Experiment Station, basing estimates on its feeding tests, concludes that highest egg production can be secured by limiting the amount of grain fed to 12 pounds per day per 100 hens from November to April inclusive, 10 pounds in May and June, 8 pounds in July, 6 pounds in August, 5 pounds in September and October; and compelling the hens to make the rest of their grain ration of dry mash. Those who undertake to apply this formula should be guided to some extent by the disposition of the hens toward eating as large a proportion of the mash as is indicated for the closing months of the laying year.

Difficulties of Feeding for Eggs in Short Winter Days

In the summer, when a pullet is doing her growing, the first and last feeds each day may be twelve to fourteen hours apart, and even when the days are not at the longest she can be feeding at some time in more than half of the twenty-four hours. But in the short winter days it becomes difficult sometimes to get in three meals a day, giving the hen feed enough for maintenance and egg production, and at the same time giving her a fair amount of exercise and keeping her in good appetite for every feed. There are often not more than eight hours that the hen can see to eat. If the weather is generally fair and bright, so that the birds get all the light there is, it is not so bad; but when there is much stormy and dull weather it is pretty hard for the poultry keeper to keep pullets laying, and harder to start those that have not begun to lay, or that began and then stopped.

Any method that will either lengthen the day, so that the hens can eat and digest a larger amount of feed; or that will conserve the heat of the body or the energies of the hen that what feed she takes will go farther—or that will supply an extraordinary amount of nourishment, will help to increase egg production at this season. Lighting poultry houses was tried long ago, though not on the same scale, nor with the provision for as thorough lighting as in recent years. Heating poultry houses—keeping the hens warm, both by the use of stoves and by providing roosting closets in which the heat of their own bodies keeps the temperature comfortable, has often been tried and sometimes with remarkably good results for the time being. Keeping the hens confined close enough to keep them nice and warm however, has a tendency to make them soft and especially susceptible to colds and roup, and if they lay well enough to justify the cost and trouble of keeping them warm and adjusting ventilation day by day with the greatest of care, they are likely to lose a good deal of vitality, and to be such indifferent layers in the latter part of the season that nothing was gained by forcing them at first.

Birds that are to be bred from the following season ought not to be forced for egg production early in the winter. If they lay well without any unusual measures the best policy is for the poultry keeper to feed them well, and when the breeding season approaches go over them carefully and take for the breeding pens only those birds that seem vigorous and thrifty, and are in good condition after having laid well in the early winter. Birds that are not to be used for breeding may be forced as much as desired and as they will stand, and it may pay the poultry keeper to do so if when he does it he will recognize that in all ordinary stocks, hens that are forced in early and midwinter are not apt to be profitable layers toward the end of the laying season.

Where a poultry keeper has a large stock and wants to have his supply of market eggs as constant as possible throughout the year, it is a good plan to take the pullets that he regards as second grade for layers, and not desirable for breeders and, taking any means that will give the results, force them for laying throughout the winter, and as soon as they begin to slack up or to go off their feed, sell them for poultry. A further advantage of this plan is that it provides for using both the stock and the equipment to the best possible advantage. Every poultry house and plant can carry more adult fowls through the winter than it can properly accommodate in warm weather. A breeder-fancier goes into the winter with his houses crowded, and by spring his sales of stock will have taken out the excess over the proper capacity of the houses in warm weather. Most commercial egg farmers try to stock to full capacity at the beginning of winter, and dispose of the poorer looking hens in each house as warm weather approaches, all having been handled the same through the winter. To separate those that are to be sold at the beginning of warm weather, and feed them to get the most eggs in winter, is to apply the same principle in feeding pullets for a short period of laying that we apply in finishing market poultry.

What can be done to secure good egg production in short winter days, by special feeding methods, depends upon how closely the hens can be looked after, and upon the skill of the poultry keeper. A person who can carry out fully and regularly a program of feeding that gives a fairly good meal early in the morning, never lets them get really hungry at any time through the day, sees that they get a fair amount of succulent feed at least several times a week, and sends them to roost every night with all crops full AND WHO ALWAYS DOES THIS, will get eggs in the short days from hens that are in the right condition for laying. But to do it he will feed in a manner that after a few months begins to break the hens down.

The writer has known poultry keepers who always got good egg yields through the winter—were never known to fail. They all went on the principle that the way to get eggs was to feed the hens all they could eat of good, substantial rations. Most of them had a good deal of trouble trying to raise chickens from their laying stock, and depended on eggs from other flocks to produce most of their pullets each year; but give them pullets at or near maturity at the beginning of winter, and they would get eggs right along, and they would do it simply by regular care and heavy feeding. The poultry keeper who was most successful through the longest period (in nearly thirty years he was not known to miss) fed a warm mash in the morning. If the mash would not freeze he put enough in the troughs to give the hens all they would eat until noon. Then about the middle of the afternoon he put their grain ration in the same troughs, giving all he thought they would eat before dark, and if the grain was cleaned up earlier, more was given. In the mornings when mash would freeze in the troughs he fed what would be cleaned up before it could freeze, and then fed again toward noon. He gave steamed clover in the mash, or fed cabbage or mangels shortly after noon.

His neighbors who were less successful used to say that he spent more time beside the fire at the grocery store a mile away than any other farmer in the vicinity, yet his hens laid when others did not. The writer repeated this to him once, and asked him how he accounted for it. He—apparently—did not at first relish the reference to his loafing habit, but after a moment laughed good-naturedly and replied: "Well, maybe I do put in more time at the store than some of the others; but I can say one thing for myself that can't be said for any of them. No one ever saw me at the store when there was work that ought to be done for the hens at home. My hens never missed a meal because I had something else on my mind. And I never tried to find out how little a hen could live on. You can't get something from nothing. If you want a hen to lay, you got to feed her: same as with getting milk from a cow."

This man was not a good all-round poultryman,—he had his limitations—but he could get eggs in the short days of winter, and he did it by feeding well and never allowing anything to interfere with feeding at the reg-

ular times. His experience and his method fit the topic under discussion, but should not be applied to all phases of poultry keeping.

The Water Supply in Winter

To keep hens properly supplied with drinking water in hard freezing weather is one of the poultry keeper's most troublesome problems. If birds with long wattles get them wet while drinking when the temperature is well below the freezing point, they are in that condition much more suspectible to frostbite than when dry. In most of the popular breeds the hens' wattles are not long enough to make much trouble on this score, but those of the males are. So where hens are kept for egg production only, there need be no trouble, for it is not necessary to keep males with them. Where the stock is to be used also for breeding, it is desirable to have the males with the females, living a normal life and keeping in good condition, though the eggs may not be used for hatching for some time. The tendency among poultry keepers who have males likely to get wattles frosted is to withhold water from the flock until the atmosphere warms up a little, and to empty out the drinking vessels early in the evening—the idea being that the birds can get all the water they really need in the few hours they have access to it, and that it is no great hardship to them to be without it for sixteen to eighteen hours occasionally. No doubt it is possible to find instances where hens have laid well when watered that way, and were able to get no snow or ice, but such cases are exceptional.

FEED ROOM, OFFICE, AND DORMITORY BUILDING AT THE GOVERNMENT POULTRY FARM, BELTSVILLE, MARYLAND

In the rear is a long laying house used for experimental pens. Photo from U. S. Bureau of Animal Industry.

Hens normally require a great deal of water when fed much dry grain. They usually want a drink before they eat in the morning, and are likely to take a drink the last thing before going to roost—if they can get it. They want water with their feed, and to limit them in any way on water will result in a smaller consumption of feed. To insure that hens will eat as much as possible in the short days, they should have water at will, and if the males need special attention to prevent frosting of the wattles, it is much better to give it than to have the hens stinted for drink, or to have the trouble of treating the male's frosted wattles, and perhaps have him out of condition when he is needed for breeding. The males can stand a short supply of water at this time better than the laying hens can, and—though it is not recommended to make a practice of keeping the males short of water at any time—in emergencies it may be the least of several evils to coop them where they cannot get to the water pail.

In many cases snow is preferred to water by hens that have access to it. Many poultry keepers do not water the hens at all when they can get snow, and there are many cases where the hens apparently lay as well with only snow to quench their thirst as when supplied with water. There are, also, many instances in which snow either does not appear fully to substitute for water, or is supposed to have some injurious effect on the hens. Eating snow is often alleged to stop laying. Whether it does so or not, the writer is not prepared to say. He has never personally known an instance where, with other conditions as they should be, vigorous, hearty fowls were in any way unfavorably affected by eating all the snow they wanted. It is probably natural for all land birds in regions where the streams and ponds are frozen over for long periods to eat snow to quench their thirst. When snow is available it is often easier to keep the fowls supplied with it than with water, and in freezing weather it is much safer for birds with easily frosted wattles. The dry snow will not adhere to them, and when the snow is wet the temperature is above freezing.

Modifying Rations As the Weather Moderates

Nearly all stock of poultry that are fed heavy rations in winter tend to develop some cases of liver trouble toward spring. This tendency will be much reduced if the poultry keeper is careful to lighten the ration whenever the weather is unseasonably warm. No radical changes need be made, but a little less corn than is used for normal winter weather, more oats—either dry, soaked or sprouted, and more generous feeding of green feed will go far to check troubles of this kind. It is particularly necessary to look out for the hens that, while hearty feeders, are rather indifferent layers and more inclined to put their feed into fat than into eggs. A hen that is in good condition and laying well seems to benefit by the warm spells in winter. Any excess of feed over maintenance requirements increases her rate of egg production—as long as her digestion and other functions are strong and sound.

A poultry keeper who trap-nests hens can watch their condition very closely. If one does not use trap nests, he should make a practice of handling his hens on the roost at night to see what condition they are in. If this is not done a novice often fails to increase rations all the hens will stand as they come into heavier laying in the latter part of the winter, and the result is that the hens producing eggs rapidly first use up what surplus fat they may have, and then turn some nutriment that should go to the maintenance of the body to the production of eggs. It is a mistake to suppose that the amount of eggs produced is determined by the supply of

material available for eggs after all requirements of maintenance have been met.

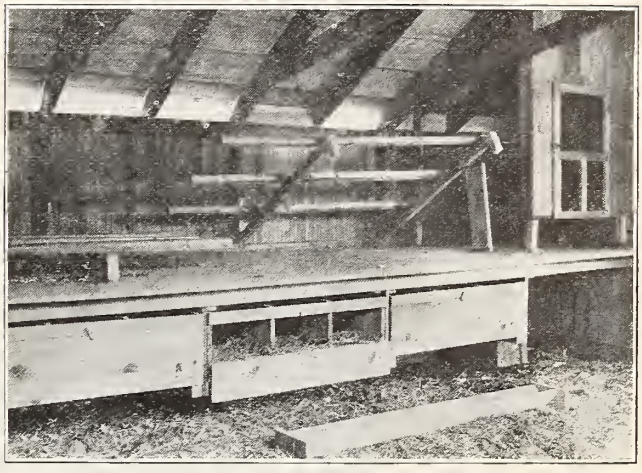
While the general condition of the hen has much to do with the rate and the regularity or irregularity of production, no function operates automatically or otherwise, on the simple basis of taking the excess of nourishment for its purposes—unless the deposit of fat is regarded as so operating, and that is hardly reasonable, because the accumulation of fat beyond a limited amount is detrimental to an organism. Yet considering the deposit of fat as a function we see this: While the chicken is growing it does not readily take on fat. As it approaches maturity, particularly if this happens to be at the beginning of cold weather, it has a pronounced tendency to fatten if feed and conditions are at all favorable. Though the tendency to produce eggs at maturity may be stronger in a pullet than the tendency to fatten, if anything disturbs the development of the reproductive system at this time the tendency to fatten is quite likely to assert itself.

Similarly, as the natural laying and breeding season approaches, the tendency is for the hen to produce eggs more rapidly than at any other time, and this is not attributable entirely to more of the feed elements becoming available for eggs, for though the period of flush production usually begins after the shortest days of winter when the difficulties of feeding in short days are over, it comes before the weather is warm enough to reduce the requirements of the hen to an extent at all equal to the nutritive elements which she at this time converts into eggs. Every hen that is capable of laying lays at the breeding season, and hens that have laid earlier will lay more freely than before. Apparently the reproductive organs of each hen work to their capacity, taking all they can get and use of the nutritive elements consumed, even at the expense of requirements for maintenance.

If this were not the case we should never have well-fed hens becoming thin and poor while laying; but they would be full and firm in flesh, though not fat, as long as they were receiving an adequate maintenance ration. In handling hens that have been laying for some time it will usually be found that some are going off in condition. This is most readily noticed by the majority of poultry keepers when hens go broody after two or three months of laying. Hens of breeds that have the incubating habit, which lay as long as that before going broody, are generally in rather poor condition when they become broody. Hens of persistently broody stocks, that go broody quite regularly after three or four weeks of laying, are usually in fair condition when they go broody. Many stocks of the breeds that commonly have the incubating habit produce few broody hens, and those only after long periods of laying, and the hens are nearly always in rather poor flesh when they go broody.

Instead of waiting to find out—as if by accident—when hens go broody or when they have stopped laying, that they have become thin and poor, the poultry keeper should, from the time his hens begin to lay, at frequent intervals, handle enough of them on the roosts at night to see what their condition is and whether he needs to handle them all. He then can take measures to prevent hens laying themselves into poor condition at the rate that is going on with the feed the hens are getting. Whether he can keep the hen laying well through the spring and summer and up to the molting period depends on the constitution and vitality of the hen. In the average stock where selection for vitality has not been practiced, probably fifty per cent of the hens could not under any system of feeding or management be made profitable layers for more than six or eight months of their pullet year.

But in the average large flock of layers, and in many smaller flocks, a considerable proportion of pullets begin to lose flesh and condition within a few weeks of the time they commenced laying. The general cause of this is failure to increase the amount of feed as the hens come to heavier laying. All poultry, laying hens as well as stock destined only for the table, should be fed to keep it always in good flesh. Then, in the case of the laying hen, we know that the hen is doing the best of which she



INTERIOR OF PEN IN THE LONG HOUSE IN THE REAR OF BUILDING ON OPPOSITE PAGE

is capable in egg production. And though a hen of only moderate vitality may not be able to go the full distance with the continuous layers in the flock, by feeding her well and keeping her always in good flesh, the poultry keeper insures that she will be a profitable layer considerably longer than if allowed to run down in flesh, and that when she quits laying she will be in fair condition to sell for table poultry.

The matter of breeding for egg production does not come under the subject of this book. Its aim is to tell every poultry keeper how to feed the stock he has to the best advantage. As was said in another connection, the tendency is for a poultry keeper's stock to adapt itself to his methods of feeding and care, by the somewhat automatic, and in some ways undesirable process of the failure of the individuals the system does not suit to thrive under it. While it is highly desirable that the poultry keeper should have stock all well adapted to his methods, that is never fully realized, and it is always good policy while culling out the unsuitable as that quality in them is discovered, to consider how to handle them to best advantage. On this principle the method of dealing with a hen of doubtful value as a layer in the latter part of the winter is different from that of dealing with heavy layers.

If some hens in a flock are laying well and remain in good condition, while others on the same ration, with the same opportunity to satisfy their wants, are in poor condition, the logical thing to do is to separate according to this characteristic; and to feed the hens that are in good condition as before, but for the others to change the feeding as seems desirable to improve their condition, with the expectation that it will either improve their production or extend their period of profitable production. If some hens seem too much inclined to put on fat they should be managed accordingly. If a poultry keeper

has carried so large a laying stock through the winter that he has to reduce in the spring, it is good policy for him to sell both fat and thin hens, keeping for himself those that stay in best condition under his feeding and handling, and that, when tested by modern culling methods, give evidence of being good layers. If he has the room, needs the eggs, and will give the matter attention, he can sort out his hens after they have been laying long enough to show how his system suits and affects them, and by giving the several types he has separated appropriate treatment, a large proportion of them may lay as well as the hens fed and managed according to his regular method and for a much longer time than if all are fed the same way, and with more profit than when those the method does not suit well are not identified until they are too much out of condition to come back within a reasonable time by any treatment that it is practical to apply.

Though at first thought the plan of sorting the laying hens as just suggested, and varying the feeding to suit the different types, appears contrary to the general advice to eliminate those that do not thrive under the methods used as soon as possible, it is really in line with it—subject to the understanding that "as soon as possible" is construed in a common-sense way to mean with due consideration of questions of profit and loss. The case of the pullet reared to maturity and carried for several months after beginning to lay is somewhat different from that of the bird which at maturity appeared an unpromising layer. The latter is reasonably certain not to lay enough to warrant keeping her through the period when even the best layers are usually giving their smallest returns. The former has been carried through that period and into the period when eggs are easiest to get. The plan suggested is essentially the same as sorting the second-grade layers at the beginning of the winter and forcing them for eggs, or as finishing any kind of poultry for market. It differs only in that, as long as the hen will lay eggs at a profit and is not taking room that could be used to better advantage by another bird, she is kept for egg production.

Thorough inspection and appropriate assortment and disposal of the laying stock is generally postponed until early summer, and the most common practice is to try to cull out at that time all hens that are not regarded as worth carrying a second year. This culling is applied generally to flocks that have uniform conditions and treatment. It is obvious that this both fails to get their best production out of a considerable proportion of the birds culled out then, and also that it misses the birds that would be culled out in a careful inspection a few months later. Thorough economic culling of poultry for any purpose is a continuous process, not one that can be allotted to one or two particular occasions in the year. There are various occasions when a thorough inspection and culling are made more conveniently than at other times, but all culling should not be left to those occasions. Birds that are plainly going wrong should be taken out of the flock as soon as observed, and such steps as are necessary to insure that birds kept will be profitable should be taken. One of the most important of these is to ascertain, after the hens have been laying a little while, what must be done to get as many eggs as possible from ALL the hens while they are kept.

Summer Management of Laying Stock

The summer feeding of laying stock is subject to the same conditions as the feeding of growing chickens. What was said in Chapter VI about feeding chickens in hot weather applies equally to feeding laying hens on range. Laying hens in confinement should be liberally supplied with green feed, and with milk if it is obtainable. Hens that are to be kept through another laying season should not be forced to keep up egg production—which can be done, as long as they will stand it—by feeding more grain than they would voluntarily take if well supplied with feeds that they relish better in hot weather; but where it is desirable to get all the eggs the hens will lay, hens that are to be sold when through laying for the season can be given as hearty a ration as they will eat. In feeding heavy rations in hot weather the poultry keeper should recognize that he is taking extraordinary risks, especially with hens that are a little fat, and should be on the lookout for any symptoms of trouble that may appear. It is wise to make table poultry of every hen that may attract his attention as apparently more affected by the heat than others. Such hens are all right for the table, but peculiarly susceptible to heat apoplexy, and of course if killed in that way are a dead loss. It is well in such cases to use the hen while she is suitable for poultry.

Many hens begin to molt before midsummer. In general these are the less persistent layers, but that is by no means an invariable rule. There are enough instances of hens that were indifferent layers in their first year being heavy layers in their second year, and sometimes in their third year, to show that the hen with capacity for heavy laying does not always fully exhibit it the first year. When we consider how many things may temporarily affect egg production, and how any check to egg production in warm weather is likely to start a molt, we can easily see that the fact of an early molt, alone, ought not to be taken as conclusive that the hen is not a desirable hen to keep over. Other things should be considered—the condition of the hen in other respects, her previous laying, and above all, any possible special cause for what appears as premature molting.

Feeding Molting Hens

The ration for molting hens need not be materially different from that fed them at other times. The quantity should be as liberal as the hen can use to advantage. The old idea was that hens molting should be fed nitrogenous rather than carbonaceous feed. It was doubtless where this practice prevailed that the benefits of feeding sunflower seeds, rich in fat, appeared greatest. As most hens are in heavy molt in the fall when the weather is often quite cool, the liberal use of corn in the ration keeps up the heat of the body while its natural covering is deficient, and it will generally be found that hens that are a little fat at molting time grow their new plumage more quickly. The live feather contains a considerable amount of fat (oil), and more during its growth than afterwards. A hen that, when well fed during the molt, appears to be taking on fat rapidly and becoming rather sluggish, may be regarded as unlikely to resume laying immediately after molting, for these symptoms indicate a general condition not favorable to the production of eggs.

Artificial Lighting

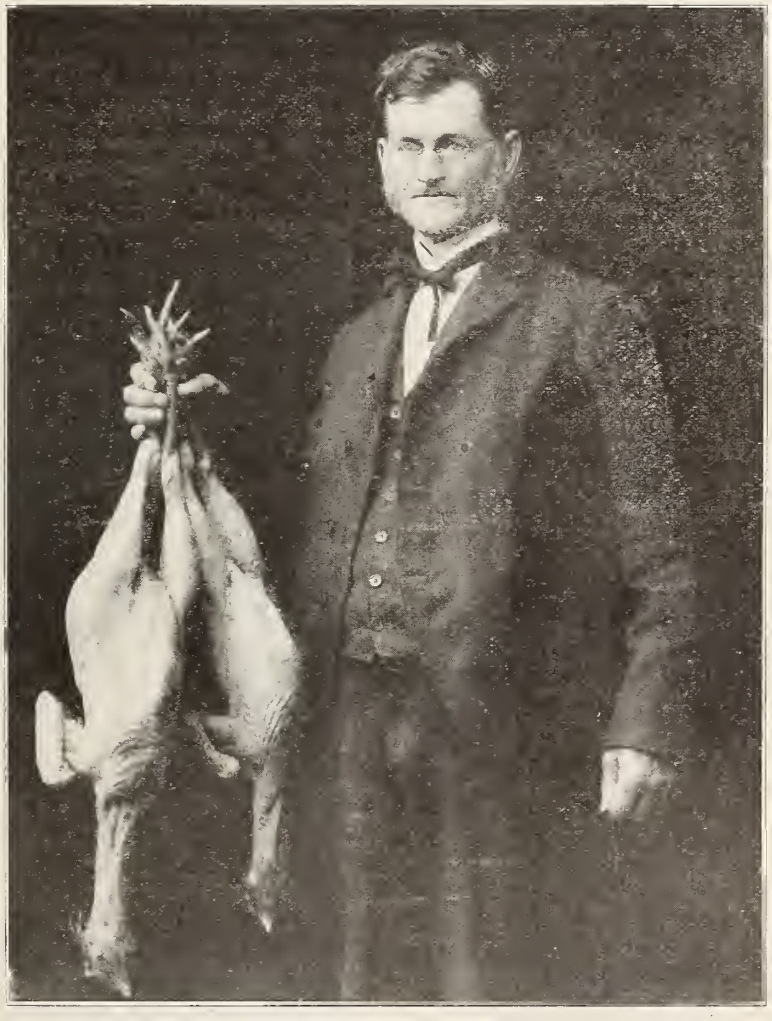
This subject, which was briefly mentioned on page 8[illegible] is very fully treated in "Use of Artificial Light to Increase Winter Egg Production" (published by the Reliable Poultry Journal Publishing Company), which gives in complete detail all the latest facts as observed at various experiment stations and commercial poultry plants, and allows the reader to draw his own conclusions.

CHAPTER VIII

Fattening and Finishing Poultry for the Table

Following Good Feeding for Growth Or for Egg Production, Finishing Processes May Be Easy Adaptations of Rations Previously Given—Simple Methods of Fattening Broilers, Fryers, Roasters, and Fowls, Best in Common Practice — Conditions Calling for Special Fattening—Crate Feeding and Machine Feeding and When These Methods Can Be Adopted

TO make good table poultry, chickens must have more fat than they normally carry while growing, or than is compatible with the highest efficiency of all the physical functions. In feeding young chickens for growth we do not usually pay much attention to the possible fattening effects of the rations given them, for under any conditions favorable to good growth in chickens the possible effects of an excess of carbonaceous elements in the ration given them are neutralized by green feed and exercise. Hence with all poultry that is destined only for the table, the practice is to feed a good growing ration under conditions that make for sound digestion and thrifty growth, until the bird has reached the stage of growth at which special feeding to fatten and finish can be commenced and the desired result from that process be obtained before high feeding affects the digestion and the bird begins to go back—losing weight and quality of flesh.



J. H. CURTISS WITH A PAIR OF CHOICE "SOUTH SHORE" ROASTING CHICKENS

Mr. Curtiss was one of the pioneers in growing this kind of poultry, became an extensive dealer in it, and in the thirty odd years he was prominent in the industry, probably handled more fowls and chickens of superior table quality than any man in America.

Where poultry is especially grown for the table the best practice is to feed and handle more with the object of keeping the muscles soft, without going so far in this that vigor and capacity for growth are impaired. With ordinary farm-raised poultry, and all stock grown for egg production or for breeding or exhibition, the point of soft-meatedness is not especially considered. The aim is to develop the strong physique and the symmetrical organism that will be effective for its purposes for several years. With all stock of these descriptions the question of finishing for the table is not a question of making superior table poultry, but of taking the birds as they are when no longer profitable for their special purposes, and making as good table poultry of them as is possible in the short period that fattening methods can be employed to advantage.

For the great majority of poultry growers, if they fed always with a view to keeping their stock in good condition, fattening for all ordinary purposes would be simply a modification of their usual feeding practice. It is when young stock is poorly grown, or old stock is allowed to get badly run down, that the average inexpert poultry keeper begins to take an interest in special fattening methods with the idea that by using them poor poultry can be converted into good. While as much fat as can be put on it, within a short time, improves the poorest of poultry, there is no process or ration that will make a first-class fat bird out of what was an inferior one before fattening. We can put on material of any kind only such finish as it is capable of taking. While special fattening processes give fine results when applied to proper material with skill and judgment, they are often detrimental when applied by unskilled persons to birds that will not sufficiently benefit by them to justify the trouble. Unless one proposes to go into fattening for market thoroughly, and on a considerable scale, it is usually better to keep to the simplest methods of fattening.

Fattening Broilers

Broilers are killed at from three-fourths of a pound to a pound and a quarter, or for large broilers up to two pounds or over. The chicken as ordinarily taken from the yard at that range of weights is not really FAT, nor will any ration that it can stand make it so. But by feeding a ration rich in fattening matter, and keeping the chickens quite closely confined, comfortable, and quiet for from one to two weeks before they are to be killed, a slight accumulation of fat

WHITE PLYMOUTH ROCK CAPONS
Photo from S. K. Burdin.

can be secured which makes them more attractive to the eye and more savory to the taste. This can be done however, only with stock of good vitality and with a natural tendancy to put on fat readily at maturity. Some what undersized and stunted birds are sometimes fed heavy rations for a longer period than indicated, and those that stand it sometimes take on rather more fat than the ordinary broiler, but they do not have the quality of the plump, quickly grown bird.

The usual method of feeding to finish broilers is simply to add more corn and corn meal to the ration, mixing the meal with milk if it can be obtained, and feeding all the birds will eat. Many make the mash two-thirds corn meal, and give cracked corn only for grain. Some chicks can stand an all-corn ration, and some can not. A most important thing in finishing broilers is to remove at once, and kill as they are, any chicks that the forcing diet evidently does not suit. Poultry keepers often leave these, expecting that they will come along, although a little slower about it than the others. It is much better to sell them for what they will bring, without further feeding, for the chances are that they will never gain enough to pay the cost of feed and care until prices have fallen.

Fattening Fryers

A fryer is a chicken usually weighing about two pounds, but occasionally much heavier. There is practically no difference between large broilers and small fryers except that the fatter chickens are more suitable for frying. In fact a chicken of what is usually frying size, if rather thin and yet quite soft meated, will broil better than it will fry. Where chickens have been raised to this stage on range, the best plan is to put them in small yards, with good circulation of air, and shade, and to give them from ten days to three weeks of high feeding before they are to be killed. The length of time must be determined by the readiness of the chickens to fatten and their ability to stand heavy feeding. If the chickens do not take kindly to strong rations, these matters can be regulated to some extent by making only slight increases in the fattening material in the feed, and by using more wheat than corn in the hard grain fed.

The safe way to feed chickens to get a reasonable amount of fat as they grow is to keep close to a good growing ration, but yard them quite closely. When this is done—especially in warm weather—care must be taken to keep everything clean, and if feed is allowed to stand before the chickens, to see that it does not get fouled. In this way chickens can be kept growing and carrying a fair amount of fat for an indefinite period, often until well grown. Such a course is especially advantageous to those who hatch or buy all their chickens at one time in the spring, and who want to have the cockerels ready to kill for their own tables through quite a long season. In this way the cockerels may be carried from broiler to small roaster size, the removals week by week making room for the growing birds that are left. If the birds are not as fat as is desired by this method, it is easy to take those that are to be killed at a certain time and put them in a small coop a week in advance, and feed a heavier ration.

Fattening Small Roasters

Ordinary small and medium-sized roasters are principally cockerels of the larger breeds, that are marketed just before they begin to become so hard-meated and staggy that they would class on the market as old cocks. The greater part of them come from the general farms, for poultry specialists usually either market their surplus cockerels as broilers, or caponize them and keep them to make large roasters. Most of the cockerels from the farms are in just fair flesh when marketed, and from one-half to three-fourths grown. They are at the stage where heavy feeding for a short period will generally increase the size, put on a fair amount of fat, and greatly improve their

A PAIR OF WHITE PLYMOUTH ROCK "SOUTH SHORE" SOFT ROASTERS

These are capons but are not dressed "capon style" —that is, with the feathers left on neck, wings, legs and part of the back. All "South Shore" stock is fully dressed for market—capons as well as pullets.

table quality. As farmers generally are indifferent to the possibilities of considerably increasing their returns from the cockerels in this way, the practice of special fattening these chickens has grown up among the poultry packers, and many of them find it very profitable. At the same time the buyers and jobbers in poultry mostly take the position that this work could be done economically and much more satisfactorily by the growers on the farms. They would rather have the grower send them finished products; but if growers will not do this, then the large buyers will engage in fattening as long as the numbers of unfinished chickens they receive make it worth while to do so.

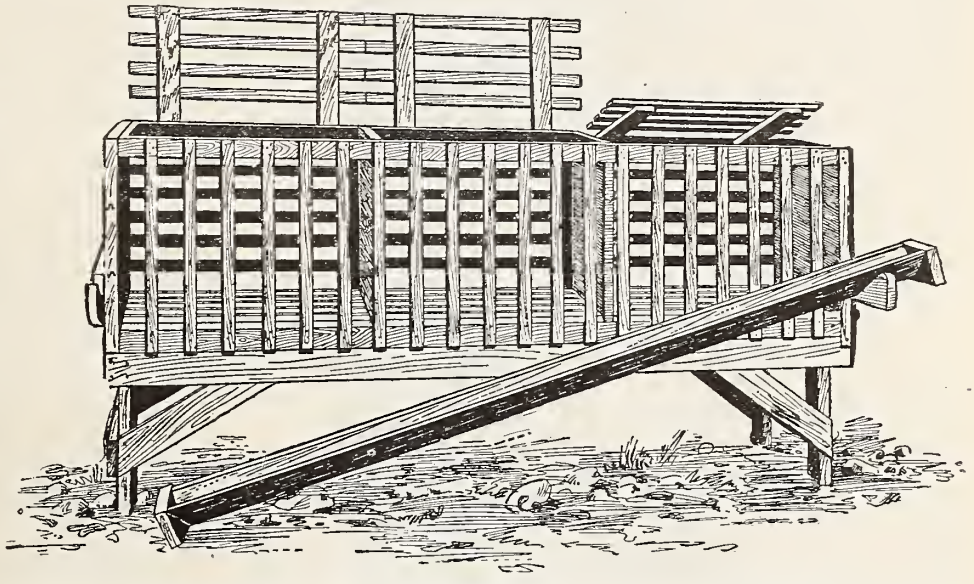
Where stock of this class has been so well fed that it is in good flesh, perhaps a little fat, and quite soft-meated, the best method is to put the birds in yards and feed liberally of a good growing ration, including a generous supply of green feed, and all the milk they will drink, keeping them on this diet for a week or two, according to their condition. Then put them in a pen that can be made so dark that they will not move about, and let the light into this pen only long enough to allow them to fill up with feed three times a day. A good ration at this time is: Two feeds a day of clean, sound cracked corn, one feed a day of a mash of 2 parts of corn meal and 1 part of wheat bran, with 10 per cent of meat scrap added. This feeding can be continued as long as the chickens eat well, or until they are as fat as desired. Usually chickens will be as fat as most people want them in a week to ten days, though many chickens that are rugged at the beginning of this course of treatment will stand high feeding in the dark for two weeks or more.

The great advantage of feeding this way is that the preliminary period of feeding makes the change from an ordinary to a heavy ration so easy that the birds adjust themselves to it without going off their feed, and when they are put on the heavy fattening diet they have become just lazy enough to take kindly to being kept in the dark after eating. In this method of fattening the risk of the birds going off their feed before they have fattened is reduced to the minimum. In it, however, and in all fattening, it must be understood that unthrifty birds with poor digestion will not fatten, and it is a waste of time and feed to try to make them do so. Any little gains that they make cost more than they are worth.

Fattening Large Roasters and Capons

Large roasters are principally capons. Where winter chickens are grown for the table, the most of the pullets are sold for roasting as soon as they begin to lay, and some growers of Asiatics have young males remain soft long enough to be sold for large roasters; but in the main, cockerels that are to be kept for large roasters are caponized. As the large roaster is carried until full grown before fattening for market, the method of feeding is not much different from that used for growing pullets for laying and stock birds. The market chickens are usually crowded a little more in the yards and houses, and fed with less attention to exercise. The less exercise they take the more economically they are grown—provided only that they take enough to ward off indigestion.

The famous "south shore" soft roasters of Massachusetts are mostly fed from the time they leave the brooders until they are ready for market on the simple ration of cracked corn, meat scrap, green feed, and water, as mentioned on page 62. This is their fattening as well as their growing ration. The principle upon which they



FATTENING CRATE USED AND RECOMMENDED BY THE POULTRY DIVISION OF THE DOMINION OF CANADA DEPARTMENT OF AGRICULTURE

are fed and handled is to give a simple, substantial growing ration—one that reduces the labor in feeding to the minimum and will produce as much fat as the bird will carry while growing, with an increased production of fat as soon as growth stops. The bird then is watched closely, and when the fattening has reached a stage which experts in handling this class of poultry judge not by the amount of fat, but by the appearance of the skin, it is marketed. The chickens grown in this way are quite different in appearance from those that put on all their fat in a short time before being killed. The fat is much more evenly distributed, and by killing when the skin shows its best texture and color the bird goes to the table when the proportion of fat to lean in the meat is most appetizing. The grower of this class of poultry characterizes the proper condition for killing as being "ripe." He holds that a chicken, like fruit, comes to a stage when it is at its best, and after that deteriorates. The term "ripe" as used by growers of poultry should not be confounded with the same term as used to express the condition of meat held after slaughter until just before the tissues begin to break down.

Fattening Old Fowls

It is doubtful whether it pays to go any farther in efforts to fatten old hens and roosters than can be done in a very short period of heavy feeding, with birds that are in good condition at the beginning of it. In flocks that are culled only at long intervals there are likely to be many old birds in run-down condition and not having good digestion, that are yet not so far gone but that proper care and feeding will, in time, make good table poultry of them. The time required for this, however,

may be so long, and the amount of feed consumed in it so great, that the operation is unprofitable. If the poultry keeper watches the condition of the stock as he should, none of the old birds need ever get so low in flesh that they cannot be made as fat as necessary for market with two weeks' feeding of a ration composed largely of corn. Any of the rations for fattening roasters will quickly make hens and cocks that are capable of taking on fat at a profit, as fat as the consumer wants them. The excessively fat hens that are often seen in the markets, which careful buyers avoid because the most of their fat can be utilized only in cooking operations for which cheaper fats will serve, are mostly nonlayers that have been in this condition for months.

Some of the special fattening methods which will shortly be described frequently fatten old fowls quicker and better than ordinary methods but, on the other hand, they so often unfavorably affect individuals, and sometimes the entire lot on which they are used, that the returns, on the whole, are no greater than if no effort had been made to finish stock before marketing. The poultry keeper will almost always find that his best policy is to feed for growth, or for eggs, and always with a view to keeping stock in good condition, and then when the time comes to sell a bird for market, whether as broiler, fryer, roaster, or fowl, he can put it in as good condition as the market requires with from one to three weeks' feeding for that purpose in ordinary coops and yards.

Crate Fattening

Crate fattening is the feeding of chickens confined in crates or coops in which they have little more than standing room, supplying mashes of the consistency of thin mush or gruel, fed to them in troughs outside the coops, from which they eat by reaching through the slats which form the front of the coop or crate. Some birds take readily to this diet and method and put on fat and increase more in growth during the period thay can stand it than when fed in the ordinary way and given more freedom. Some it does not suit at all, and the matter of first importance where crate fattening is practiced is to judge at the beginning of feeding what birds can be profitably fed in this way and what cannot, and not use the method on birds with which it does not agree. This is something that of course can only be learned by experience, and the novice must expect to make some mistakes.

Crate fattening, or any other special process of finishing poultry for the table, is of some interest to everyone who grows any considerable amount of poultry. It is worth while to know something of these methods even if the poultry keeper has no occasion to use them regularly. There are times when ordinary methods are not giving results as quickly as desired. Thus when it is important to put chickens in good shape for killing in hot weather, and they either have a poor appetite for the ordinary hearty ration, or it does not seem to agree with them, the soft, semiliquid feed mixed with milk, which is preferred in crate fattening, can often be used for as many feeds a day as seems advisable. This feed, in fact, is much like the mashes mixed with milk which are recommended for chickens in hot weather, except that it is thinner, and instead of using bran to make the mash light, corn meal, oatmeal, or other substantial feed is used.

Consideration of the points involved shows quite clearly that to add to ordinary fattening processes what may be of particular value in special fattening methods does not necessarily call for the appliance and the method used in crate fattening. The essential things in fattening are to get the bird to eat as much as possible of highly nourishing feed that agrees with it; to keep it contented, comfortable and quiet, that all the nutriment possible may go to fat, or to flesh and fat; and either to modify the ration to meet requirements when it seems to be having slightly unfavorable effects, or when these are more serious, to dispose of the bird before it loses any of what has been gained. The crate is simply a convenience, adapted especially to the use of fatteners who do not grow their poultry, or to times when a poultry grower finds it more convenient to feed a few birds this way than to give them space that he needs or can use to advantage for other poultry.

It makes little, if any, difference whether the birds being fattened eat the grains given them in the form of an ordinary mash, and drink a certain amount of milk with it, or take the same groud feeds mixed in the milk. After feeding a soft, semi-liquid mash for a time one cannot well go back to hard grains without more disturbing effects on digestion than the soft feeds are causing, but while the birds are accustomed to a considerable part of hard grain in their diet the increase of soft feeds and milk mean greater efficiency in the use of the hard grain consumed. Up to the point when indigestion begins, the birds will eat more of a mixed hard and soft diet than of either alone; after that they will be likely to eat more and benefit more on all soft feeds.

Rations for Crate Fattening

Bulletin No. 21 of the United States Department of Agriculture gives detailed reports of the fattening of nearly 900,000 chickens at commercial poultry fattening stations where buyers of poultry were equipped to keep and feed large numbers of poultry as long as profitable gains could be made. The following were the rations which gave the best results in this work. For convenience in reference, numbers are given following those in Chapter VII.

Ration No. 42:

I—Corn meal 3 parts, low grade flour 2 parts, shorts 1 part.
II—Corn meal 3 parts, low grade flour 2 parts.
III—Corn meal 5 parts, low grade flour 3 parts, shorts 1 part, 5 per cent tallow.
IV—Corn meal 3 parts, oat flour 2 parts.
V—Corn meal 4 parts, low grade flour 2 parts, shorts 1 part.

These mixtures were all fed in the same way, mixed to the desired consistency with condensed buttermilk, fresh buttermilk, or water, as available. When the supply was sufficient, 10 gallons or more of condensed buttermilk, or the same quantity of semisolid buttermilk suitably diluted, was fed with 100 pounds of grain. It was found that when an expert and careful feeder attended the chickens and saw that they had all they would eat twice a day, the gains were the same as when the birds were fed three times a day, while the consumption of feed was a little less. With indifferent attention to feeding the results were more satisfactory when three feeds a day were given. In warm weather, rations with the lowest proportion of corn meal and flour, and with large amounts of buttermilk, gave best results. At this time the period required to fatten was usually about fourteen days. In the cooler weather of fall, when heavier rations could be used and the birds' appetites were better, the usual length of the period of feeding was six or seven days.

In commercial fattening the feeder has many difficulties to contend with that the grower need not have.

The chickens on a commercial fattening plant come from here, there, and everywhere, and many of them have been so long in transit, or held under unfavorable conditions and without proper feed and care by country buyers, that they are in poorer flesh than when they left the farm, and perhaps are out of condition otherwise. It is a common practice to feed poultry in their shipping coops while being held in small numbers and in transit, the grain being put on the bottom of the coop which is foul with their droppings. Not only is hard grain fed in this way, but also sloppy mixtures of ground feeds. A large proportion of chickens subjected to such treatment suffer the usual consequences of eating polluted feed, while the crowding and exposure cause roupy conditions. These troubles the grower can entirely avoid. The poultry grower ought also to consider that a considerable part of the losses which result from these things comes back on him. It is by no means all passed on to the consumer. The buyer (the middleman) protects himself by keeping his original cost as low as possible.

Ration No. 43—An Ontario Agricultural College Ration

I—Barley meal 2 parts, corn meal or chop 2 parts, shorts or middlings 2 parts, finely ground oats 1 part, animal meal 1 part. This is mixed with about one and a half times its weight of skim milk and fed three times a day. The birds are given water twice a day.

II—Corn meal 2 parts, ground buckwheat 2 parts, pearl oat dust 1 part.

III—Corn meal 4 parts, ground buckwheat 2 parts, pearl oat dust 2 parts.

II and III are substantially the same ration modified in II for hot weather and in III for colder weather. Pearl oat dust alone is recommended as a good ration when the cost is reasonable It is interesting to note that the average amount of feed to make a pound of gain in a series of crate-fattening experiments at this institution was 3.3 pounds—almost exactly the same as the average for a pound of growth as reported from the same place in the preceding chapter.

The Cramming Method of Fattening

In England and on the Continent of Europe where there is some demand for excessively fat poultry, the practice obtains to some extent of cramming the birds by forcing feed into the crop in larger quantities than the bird would voluntarily take it. Efforts to introduce this practice into America have never met with much encouragement. Two things are against it here—the cost of labor, and the limited demand for poultry with more fat than can be put on it by ordinary methods or by crate feeding. The method is shown in an accompanying illustration. The successful practice of it requires a considerable measure of judgment in the selection of birds for the process and of skill in forcing into the crop without particular distress to the bird all the feed that its system can stand. By this process birds can be made enormously fat. The feed used is the same in substance as in crate feeding, but must have the milled stuffs very finely ground and must be thin enough to go through the tube and nozzle by which it passes from the feed reservoir in the cramming machine into the crop of the bird, without clogging.

A CRAMMING MACHINE FOR SPECIAL FATTENING FOWLS

In cramming or force-feeding, the machine hopper is filled with a gruel-like mixture of finely ground grain and milk or water, and by pressure upon the pedal the feed is forced into the crop. In using the machine, operator always keeps one hand on the fowl's crop to gauge the quantity that can safely be fed.

CHAPTER IX

Feeding Breeding and Exhibition Fowls

Good Laying Condition is Good Breeding Condition—Extremely High Production and Repression of Egg Production Prior to the Breeding Season Are Alike Detrimental—Moderate Winter Egg Production Keeps Hens in Best Condition for the Breeding Season—Feeding Before and After Exhibition—Feeding Bantams to Get Small Size With Normal Development

THE greater part of the poultry grown in this country each year comes from hens that are kept primarily for layers, or that, if not kept for that purpose, lay a considerable proportion of their eggs before and after the breeding season. So, except in the case of a small proportion of hens of unusual standard quality and value for breeding whose eggs are incubated through the entire season of their laying, the work of a hen as a producer of eggs for the table is quite as important to her owner as her work as a producer of eggs for hatching. Both purposes have to be considered in feeding the breeding stock. And even when the breeder of high quality standard stock takes the position that, if a hen of quality gives him in the breeding season a few chicks of superior quality she has earned her feed and keep for the year (though she may not lay more than a dozen eggs in the year), what seems financially justified is not biologically good policy.

To be in good breeding condition a hen must be in good laying condition. To show her type truly when exhibited she must be in good laying and breeding condition at the time. That is what the Standard demands and the judge who fails to give due consideration to that requirement is ignoring and perverting the application of the Standard no less than when he misapplies other specifications. From what was said in Chapter VII of the effects of change of location and treatment upon egg production, and of the reaction of such things upon the reproductive system—especially just before a pullet begins laying, it is apparent that the policy some breeders follow of trying to prevent birds that would lay early in the winter from doing so, in order that they may not exhaust themselves in any measure before the breeding season, has its peculiar risks, and is as likely to defeat as to serve their purpose.

Refraining from the use of such forcing methods as would be used in efforts to get as high egg production as possible, is about as far as a breeder can safely go in his efforts to retard laying until the approach of the breeding season. To feed light with the idea that the ration will be only a maintenance ration, and the hen will not lay because she has not sufficient extra nutriment for egg production does not give the expected results at all uniformly. Some hens will begin to lay and lay themselves poor under such conditions. If they are fed well and kept in good condition and their rate of egg production is moderate through early and midwinter, thoroughly vigorous hens will be in pretty fair condition for producing chickens up to the latter part of April or the middle of May, according to the latitude, but unless they have a break in the laying at some time in the late winter or early spring, the chickens they produce in the latter part of the season are not usually worth much. The greater number of hens from which eggs are set lay few eggs before February and, not having been in good laying condition through the winter, usually turn out to be not in very good breeding condition until they have been out on the land for a month or so.

Where egg production is checked until near the breeding season, either by intent or by failure to give care to put and keep hens in laying condition, the general effect is the same. Men may theorize all they please about keeping their hens from laying in the winter that they may get stronger, more vigorous chickens in the spring, but when fertility is poor and the chickens inferior for some time after the hens start laying in the spring, it is clear that the hens would have been no worse, and the poultry keeper would have been better off, if they had laid moderately all winter. Pullets commonly fail to lay as early in the winter as is desirable when they are kept primarily for egg production, because of the difficulties of getting them hatched and grown, and into regular laying without being affected by the many things that may retard laying. It is poor policy for a poultry keeper to manufacture such difficulties for the purpose of keeping a pullet from laying for several months after she would begin if not interfered with.

COMFORTABLE COOPS, GOOD RANGE AND REGULAR FEEDING START THESE VALUABLE WHITE PLYMOUTH ROCKS ON THE RIGHT ROAD TO BEST DEVELOPMENT

The breeder who is an exhibitor has to take chances with the birds he exhibits. Their experiences in being shown may or may not seriously interfere with their laying, but to make a reputation for his stock he must show his best birds no matter how it affects their egg production. For the rest of his stock, the aim always should be to keep it in laying condition and also in breeding condition continuously, yet never to force beyond the

rate of production that the hens will maintain on average good rations, with plenty of variety and plenty of exercise. In general, breeding stock gives best results when given considerably more yard room than is necessary for hens kept for laying only. When hens are laying in close confinement and are well fed they usually lay rather better than when given a large range. In nearly all cases,

FAVORABLE CONDITIONS FOR GROWING STOCK
With plenty of room and both sun and shade, chickens that are well fed grow big and husky. Photo shows Mr. Jos. Mason, a veteran utility Light Brahma breeder.

other things being equal, hens that are liberally fed meat scraps or green cut bone will lay considerably more than those that are not.

So by giving his breeding stock large yards or fairly good range, and by keeping highly concentrated animal feeds out of their rations, the poultry keeper can keep their egg production 20 to 30 per cent lower than it would be with heavy feeding of animal matter in confinement. Many observations indicate that the substitution of milk for meat scrap in rations fed to breeding stock gives much better fertility in the eggs, and stronger germs, yet the evidence on this point is not so one-sided that it can be affirmed that the feeding of rations containing heavy percentages of meat invariably makes for lower fertility and vitality. Matters relating to fertility are the most complicated and obscure and the least understood of all questions that call for consideration of poultry keepers; and comparisons of results in different flocks, handled by different persons under different conditions, throw no light on the subject except as careful observers are able to make first-hand studies of cases. Practically no systematic work of this kind has been done. All the comparative observations on fertility that have been published are for different flocks on the same plant.

The writer regards it as quite improbable that the feeding of any article of poultry feed is, in itself, capable of having any marked influence on fertility—either one way or the other. But high feeding is generally more or less detrimental to fertility in all animals, and it is to be expected that in a comparison between results of feeding breeding stock a hearty grain ration made richer by the addition of highly concentrated animal feeds, and the same ration modified with milk, the latter would quite regularly show the best fertility. At the same time it is in line with many observations, and altogether reasonable, to suppose that the same difference would follow were the ration modified in some other way—as by the feeding of green feed to the extent that would modify a grain and meat ration as much as an unstinted allowance of milk modifies a grain ration.

In practically all statements of rations, the amount of green feed consumed is either an unknown quantity, or is much less than poultry would consume if they could get all they wanted. Breeding stock on range on grass land, or on land growing a crop which the poultry do not eat, and from which they take as vegetable feeds, grass and weeds, will get also large quantities of worms and insects. Breeding stock in poultry yards sown to rape or a similar growing crop, to which they are allowed access only as they eat it quite clean, and breeding stock in yards which afford no green feed, but where green feed of some kind grown outside is supplied as freely as they will eat it, cannot get any considerable amount of animal feed for themselves.

In such cases some concentrated animal feed is necessary—not so much as when it is desired to secure the heaviest egg production possible under similar conditions, but still enough to make a mash appetizing. It is desirable, whenever it is practical, to keep breeding fowls where they will be well fed on a variety of feed without giving them anything but a little hard grain. But only the small breeding flock on a relatively large and good range can have these advantages, and when the truth about this matter is told, the bulk of the better-than-average standard stock produced every year comes from breeding stock that has not by any means ideal conditions of range, but is given, as far as possible, the care necessary to make up for this lack.

The less concentrated rations, whether modified with milk, or with vegetable feed, generally give a smaller egg yield. As between hens kept under the same conditions it is often noticeable that if one pen is laying very heavily, say up to 75 or 80 per cent, and another is laying about 50 per cent, the pen having the lowest egg yield will give the best fertility and the most chickens. Both pens being fed alike it would appear that the ration was a better laying ration for one pen than for the other—that the pen that laid at the lowest rate would need something more stimulating to bring it to its best in egg production. Most people in feeding poultry seem to find it easier to make the changes necessary to bring up egg production, than to make those that will slow up egg production without putting the fowl out of condition. The best way to do this is gradually to cut out all ground feed, giving less of it each day for about a week and then stopping it entirely, but feeding liberally of wheat, barley, heavy oats, or hard, bright cracked corn, until the egg production goes down to about an average of 50 per cent. If it seems likely to go below that feed mash and meat or cut bone moderately until it comes back and is held at an average just above 50 per cent.

At this general rate of production most of the hens in a flock will throw good strong chickens and do so until quite late in the season, even though they have laid continuously through the winter and spring. The hen is in better condition, her vitality is better maintained, and she has more of it to transmit to her offspring. If kept through the breeding season on a diet and system that gives only what may be regarded as a normal production of eggs for so long a period, she is also more likely to lay well through the remainder of the year, when her eggs are used for the table.

Feeding in Preparation for Exhibition

Theoretically, birds that are bred right—for the right size, weight, and type—and grown right (if young), or kept in normal condition through their molt (if old), do not require any special feeding. But the seasoned ex-

hibitor neither takes it for granted that any of his well-fed birds will be all right to take out of the flock and put in the showroom, nor does he put off inspection of the birds from which his entries will be selected until time to begin the work of grooming and training them for exhibition. Long before the time for that he has noted the most likely candidates for competitions, and from the time a bird is thus marked in his mind he watches its condition closely, and if it does not appear to him to be growing and developing, or molting as it should, he takes such measures as seem advisable to insure better development.

In giving exhibition stock the finish in form and plumage that birds must have to stand well in poultry shows of the first class, conditions of life count for as much as feed—sometimes more. And this applies not merely to conditions of life in a short period before the exhibition at which the bird is displayed, but to conditions from the time of hatching. Crowding in the coops and houses, confinement in bare yards, and even overstocking the range for growing chicks as much as might be admissible with birds for breeders (not to be exhibited) if well managed in every other respect, must be carefully avoided. Nearly all consistently successful exhibitors at the leading shows give their stock far more room, both indoors and out, at every period of life, than is generally considered necessary. To one who does not appreciate perfection of finish in fowls, and how much this depends upon natural conditions of life, it often appears that the breeder of first-class exhibition stock is not making good use of his opportunities—not half utilizing the capacity of his land and equipment. But the exhibitor has learned by experience that though much may be done to improve a specimen by extra feed and care in a few weeks prior to a show, it is only the specimen that has little wrong with it when taken in hand at that time that will respond to treatment in a measure that justifies the trouble.

With experienced feeders and exhibitors who have grown their stock well and kept old birds in good condition, special feeding for exhibition is mostly a matter of hastening or retarding development of specimens, as far as that can be done without radical treatment, in order to have them in their best condition at the time they are to be shown. Birds are at their best in color and condition of plumage for only a short time after the coat of feathers is fully grown. Hence exhibitors plan to have certain birds ready for certain shows. If the birds develop according to expectations, no special feeding is necessary. But if a bird is coming too fast or too slow the poultryman tries to retard or to hasten development accordingly. Also it frequently happens that an accident to a bird selected for exhibition at a particular show makes it necessary to substitute a less mature young bird, or an old one not so far advanced in the molt, and perhaps not up in flesh; or a slight indisposition may put a bird back; or something may interfere with the work of a poultryman to such an extent that through no fault of his the stock generally needs extra care. Under any of these conditions the birds that are to be exhibited must have forcing feed to put them in condition seasonably. Finally, as most birds that are shipped any distance to shows lose considerable in weight and condition before they get back home, it is desirable that the bird sent to the show should start with a little reserve of fat. The exhibitor of poultry is, in his field, as much interested and as proficient in "fleshing and fattening" poultry as is the producer of fine table poultry in his.

In all the literature on this subject there has never appeared a more pertinent and concise statement in regard to the feeding of birds in preparation for exhibition than the following from the pen of Mr. A. C. Smith, published twenty years ago, yet as applicable today:

"To get the required amount of exercise in confined quarters, a litter of leaves, coarse hay, or rye straw should be placed upon the ground to the depth of four or five inches. A few oats should be scattered in this as soon as the birds are fairly off the roost in the morning, if it is during the short days of winter. Then as soon as the mash can be prepared the birds should receive about two heaping teaspoonfuls each. This small quantity warms them up, and sets the machinery of their digestive organs to work, but is not enough to destroy their appetite for more. This mash should be made of ground oats and corn meal; or corn meal, flour, middlings, and bran. The proportions should be governed by the quality of the goods. A mash that is so light in substance that it does not cling together is not rich enough; neither is a tough, doughy mash what is desired. This mash should be seasoned lightly with salt, but no spices whatever should be used, as they tend to intensify the color of the head parts for a time only, and to diminish it in proportion afterwards. It is also advisable to use a small quantity of bone meal in the mash every morning, and twice a week a little refined fish meal, say, one-twelfth or so. This is a forcing feed and but little should be employed unless it is desired to bring females toward a laying state. Clover meal should be used once or twice a week in this morning mash. It is preferable to cut clover as the latter is too bulky in the crop, and often clogs the passage to the digestive organs.

"The fowls should be kept scratching until noon, when the green feed should be given. Everyone has his preference. The writer prefers cabbages, as they are the greenest and tenderest things to be procured in the winter months. Green feed can be placed before them in two days; it may be chopped and a certain amount fed

A BREEDING PEN OF RHODE ISLAND REDS ON THE FARM OF LESTER TOMPKINS, CONCORD, MASSACHUSETTS

From a photograph by the author in the spring of 1907. This pen was of birds then eight years old that had been kept mated just as shown in the picture for seven years.

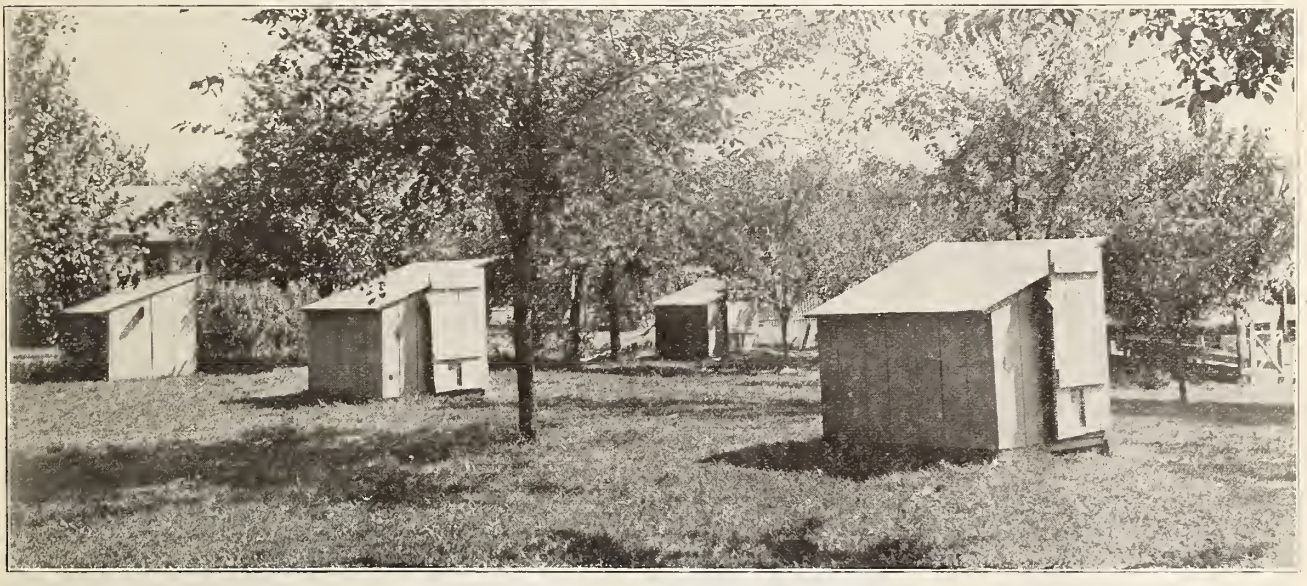
every day, or it may be given in unlimited supply. If it is furnished without restriction it must be kept constantly before the fowls otherwise they are liable to eat too much when a new allowance is supplied.

"Between three and four o'clock the fowls should be given the heartiest meal of the day. The exact time that it should be given depends upon the length of the day. The object is to give the fowls an hour to an hour and a half of exercise before they go to roost. Considerable can be accomplished by a selection of grains. If the birds are too fleshy, more barley and less wheat should be used for the evening feed. Wheat and barley are the best feeds at this time. If the weather is very cold, and the birds in a normal state of flesh, a small handful of corn may be allowed each one just before it jumps on the perch for the night. With fowls that are in poor flesh it is well to use more wheat and but little oats or barley for a scratching feed. Corn should be given for the evening feed to birds in this condition.

"Young birds of the heavier breeds which are somewhat underweight should not be forced to overexercise. In such cases increase of weight is the main point, but a moderate amount of exercise will prove advantageous in these cases also. A great variety of feed should be sought for such birds. The mash should have a greater proportion of corn meal. Broken sweet crackers of all sorts may be used to good advantage in connection with corn meal and bran as a soft feed. In cold weather sunflower seeds and buckwheat in small amounts are good agents in securing the desired object. They are also instrumental in procuring the lustre of plumage so much desired by exhibitors. Beef tallow is very good to give a lustre to the coat. Too much is not beneficial to the health of the bird, but a piece one-half the size of an English walnut every second day will answer the purpose, and prove a great treat to the birds."

As a substitute for sweet crackers mentioned above, which cannot always be obtained, many exhibitors use sugar, giving from a teaspoonful to a tablespoonful per bird in the mash. It is regarded as particularly useful where it is desired to increase weight rapidly and temporarily. As soon as a bird fattened on sugar has that article taken from its ration, the fat it had supplied begins to disappear. As far as weight alone is concerned, heavy feeding for a short time before a show will accomplish a great deal. It is not difficult to add from a pound to a pound and a half to the weight of a nearly grown, but thin bird of medium size in a few weeks—and even more to a large-framed bird; but the faults in plumage that come from limited nourishment while the feathers are growing cannot be greatly helped by any course of diet.

The use of condiments and drugs of various kinds in fitting birds for exhibition, which was somewhat common in early days, is now little practiced. Fowls have to be rugged and firm in flesh to stand up in an exhibition coop for five or six days and evenings, and giving them "dope" of any kind beforehand while it may serve as a stimulant for the first day or two leaves them much worse through the latter part of the show than if they had been given only wholesome feed. Most old exhibitors have at hand at shows a few simple remedies or tonics to give to birds that may become sick, but beyond that they rely upon the appropriate use of ordinary feeds to put and keep the birds in as good condition as is possible under the stress and excitement incident to exhibiting them.



SCENE ON BLUE ROCK FARM, IOWA CITY, IA.
Colony houses ready for exhibition pullet stock when the chicks are weaned.

Feeding Birds After Exhibition

The experience of a trip from home, from four to six long days in the showroom, perhaps with irregular feeding, overfeeding at one time and a long wait for feed at another, and a return trip, in all making usually six to eight days of abnormal and disturbing life, puts most birds somewhat out of condition, and is apt to start many cases of mild indigestion. Probably the majority of birds returned from exhibition are in rather poorer condition than when they went. Birds of the heavier breeds, however, and especially old birds that after a day or two appeared tired and sluggish, and that were fed freely, are apt to be overfat and also considerably lower in vitality than when they left home.

Birds that are below par in condition should not be put immediately on a full, heavy ration. For a day or two, about three-fourths of what they had been eating before going to the show is enough. On this the digestive organs will soon come back to normal, the birds will be bright and lively and have keen appetites. Good, sweet, succulent feed is the one thing that may be given them from the first without stint; for it is the great regulator of digestion. The ration can be gradually increased until,

at the end of a week, they are getting their accustomed allowance.

Birds that are overfat when returned from a show should be put at once on a diet of hard grain and succulent green feed, giving little corn, and making them work a reasonable amount for the light feeds of other grains necessary to put the digestive organs in good condition while the birds are reducing weight and getting in trim again.

Experience shows that full return to good breeding condition and fertility usually takes several weeks, and in many individual cases may take several months. It appears to be largely a question of how sensitive a bird is to change, excitement, and irregular life, and of the extent to which it has been shown. Neither the looks and actions of the birds nor the egg production of the hens will show with certainty when they are in good breeding condition again. The test is the fertility of the eggs and the vitality of the chickens hatched, and this appears to be associated with and dependent in part upon conditions of the nervous system and of the reproductive organs that continue to affect the breeding power of a bird sometimes long after it appears to ordinary observation to be in perfect physical condition.

Feeding Bantams

The size of a bantam is determined primarily by selection in breeding, but may be influenced considerably by feeding. In nearly all bantams the object is to have the birds as small as possible, yet with the type of the large breed of which they are miniature reproductions. The development of the appropriate type is much influenced by conditions. In all but the Cochin and Brahma Bantams the best chickens are grown, and the breed type well preserved when the birds are at liberty on a good range, and given no feed but a little fine chick feed—only enough to insure that they will be well nourished. Growing the Asiatic Bantams in this way usually results in making the birds too slender in form, a little too high on the legs, too long in the neck, and too active to show good type. There is also a tendency to shorter and less profuse feathering when the birds range much. The best way to grow this type is in grass yards that give plenty of green feed and animal feed, yet limit the ranging and the activities of the chicks, and to feed them about as other chicks are fed, except that only fine grains should be used, and comparatively little soft feed. The fine commercial chick feeds generally are splendid feeds for bantams.

Starving or very short feeding to reduce size will keep down weight but is apt to spoil type in any breed, and certain to prevent the production of the finest quality in color of plumage. It also greatly reduces the vitality of the birds and this, no doubt, is the cause of exceptional delicacy in many stocks of bantams. The best breeders of bantams now follow the policy of feeding for fair development of body with good quality in plumage color, and consider the production of a proportion of birds that are overlarge as less objectionable than to have all birds small and all more or less defective in plumage.

YOUNG BIRDS MAKE THEIR BEST DEVELOPMENT UNDER THESE CONDITIONS

CHAPTER X

Feeding Turkeys, Peafowl, Guineas and Pheasants

Differences in Feeding This Class of Poultry Due to Size, Habits of Life, and Susceptibility to Unfavorable Conditions in Domestication—Rations Used by Successful Turkey Raisers for Breeding Stock and for Growing and Fattening—Feeding of Peafowl Practically the Same as of Turkeys—Guineas and Pheasants Thrive on Common Poultry Feeds

THE four kinds of poultry considered in this chapter have much the same general feed requirements and feeding habits as chickens, but are less domestic, more restive under restrictions upon their movements, and more susceptible to the effects of contaminated soil and polluted feed and drink. These characteristics make the profitable raising of turkeys and guineas depend very much upon opportunities to give them range where they can procure the greater part of their feed by foraging, and where they will not be seriously molested by their natural enemies. Under such conditions the feeding of the adult stock is a comparatively simple matter. To start any considerable number of young birds and bring them with slight losses to the size at which they become safe from their smaller and more numerous enemies, however, requires keeping them under control and surveillance while they are small, and for this reason they generally have to be kept near the dwelling of the person having them in charge, and fed with more care during that period than chickens.

Peafowl and pheasants are kept more for ornament, and usually in much smaller numbers, and because of the greater rarity and value of the stock the tendency is to restrict them more. This is likely to make conditions so much more unfavorable than for turkeys and guineas that in general experience the peafowl and pheasants seem more delicate and difficult to raise. The almost universal tendency among those growing any kind of poultry which they find rather delicate is to feed something out of the ordinary—something supposed to be peculiarly suited to the young of the kind of stock handled. Instead of doing this the novice in growing these kinds of poultry should seek to provide the best substitute practical for the natural conditions most favorable to the birds, and feed them as he would chickens under the same circumstances, making proper allowance for the size of the birds in feeding grain. Young guineas are smaller and young pheasants much smaller than average chickens at hatching, and they need the finer cracked grains for a longer period—just as bantams and the smaller varieties of chickens do.

A point to be considered in relation to the greater susceptibility of these kinds of poultry to contaminated soil, and the possible occasion for careful dieting of birds which are easily affected by it, is that in all somewhat rare kinds and varieties of poultry, selection for vigor and vitality is likely to be much less rigid than in the popular and plentiful stocks. The writer has frequently seen turkeys, guineas, and pheasants doing as well as chickens under conditions not desirable for poultry of any kind, and with care that was neither expert nor regular. One brood of six or eight guinea chicks, in particular, kept until about eight weeks old with a common hen mother in a coop about three by four feet, made of rather wide boards with narrow cracks between, and after that put in a coop about twice as large and kept there until winter, all lived and grew to fair size. The coop first used was kept in a place where the sun beat down hot on it nearly all day, and was rarely moved. My attention was attracted to it because in passing the place a number of times in the heat of the day on some hot spring days I noticed this coop, which I supposed contained young chickens, standing where the sun beat in on it and not a breath of air was stirring. As I was acquainted with the old lady who occupied the house and knew that she was frequently away all day, I finally stopped one extremely warm day when the house was closed to see if the chickens were suffering and if there was any way I could give them relief. To my surprise, when I came close enough to see, the young birds were guineas. Next day I stopped to see the lady and suggest that if she hoped to raise any of them, better and more roomy accommodations should be provided. She assured me that she thought the birds would do very well as she had some years before raised some in just such a coop. It was only after much urging that she engaged a boy to make a coop with more room, and adopted the plan of moving the coop to clean ground at long intervals.

Guineas that will live and grow as well as those did under the circumstances were as immune to all the dangers of such conditions as any stock could be. Turkeys are often grown in small numbers in confinement, and sometimes make good growth. Many growers of pheasants are as successful with them as with chickens under the same conditions. It is doubtful whether there is any profit in stock so raised, but the fact that it can be done is of interest to many persons who are deterred from raising some of the other kinds of land birds used as poultry because they suppose that it is useless to attempt to do so unless they provide special feeds and give much more attention to feeding them than to feeding chickens. From such cases as that cited it appears that good, vigorous stock is half the battle, and that, if the birds have the vitality to start with, something may be done with them under ordinary conditions in which chickens are grown, though better results are obtained with less effort when turkeys, peafowls, guineas, and pheasants are on good range not much used by other poultry. The great trouble in managing all these birds is the difficulty of keeping them in bounds. They are inclined to wander

THE START IN THE SPRING
Photo from Bureau of Animal Industry, U. S. Department of Agriculture.

much farther than chickens and, as the young birds can fly out of any uncovered enclosure at an age when chickens are restrained by low fences, the keeper has little control over them unless they are in close quarters.

Although the feeding is so like the feeding of fowls that any poultry keeper who can grow good chickens should be able to adapt the rations used to the other kinds of domestic land birds with good results, and easily learn by observation what changes might be made in them to advantage, a few examples of the rations for each kind will be helpful to most readers and will show the differences in the methods of giving similar rations:

RATIONS FOR TURKEYS

No. 44—J. F. Crangle's Rations

I—FOR BREEDING STOCK—
Feed mostly on oats scalded, give corn about twice a week. Furnish charcoal and oyster shell in boxes from which the birds can help themselves.

II—FOR YOUNG TURKEYS—
Four times a day give stale bread (from three to ten days old) moistened with milk. In wet, cool weather put a little red pepper in this feed. Give clabbered milk to drink. After about three or four weeks, begin to feed wheat and cracked corn. Scalding the grain makes it easier to digest. The scalded grain should not be fed until cool.

III—FATTENING IN THE FALL—
About October 1st begin to feed twice a day what whole corn they will eat up in a few minutes. The birds will fatten better if allowed to range than if confined in pens.

No. 45—Rhode Island All-Corn Ration

Use only northern white flint corn. Give this to the little ones coarsely ground and mixed with sweet or sour milk, or made into bread and moistened with milk. Give this at first four or five times a day. After a short time feed with it a little dry cracked corn, and also substitute gradually for the ground corn, cracked corn soaked in milk. By the time the birds are eight weeks old they should be getting all cracked corn either dry, or partly moistened with milk. After June 1st birds on range should need feeding only twice a day. Where the range is good and the flock of only moderate numbers, they often need no feeding from August 1st until October. While the range supplies some feed in the fall, the birds are fed light feeds of whole corn twice a day. In November, to fatten fully for Thanksgiving, they are fed all the whole corn they will eat three times a day.

No. 46—Turkey Rations Recommended By the United States Department of Agriculture

I—FOR BREEDING STOCK—
If the birds are on range, a good feed of grain—preferably oats or wheat—is all that is necessary. In winter feed twice a day on equal parts of oats, wheat, and corn, with any succulent green feed. Supply animal feed by giving meat scraps, beef livers, and lungs, or skimmed milk—sweet or sour. Give free access to grit, shell, and charcoal.

II—FOR YOUNG TURKEYS—
1—Hard-boiled egg chopped fine and corn bread crumbs for the first week, then whole wheat and hulled oats.
2—Stale bread soaked in milk and squeezed dry for the first few days, then common chick feed.
3—Clabbered milk seasoned with salt and pepper, and corn bread crumbs.
4—Equal parts of pinhead oats, whole wheat, and cracked corn.
5—Cracked wheat.
6—Corn meal 3 parts and wheat bran 1 part, mixed and baked into bread.
7—Bran or middlings 2 parts, cracked Egyptian corn 1 part, wheat or hulled oats, or a mixture of the two, 1 part.

III—FOR FATTENING—
Feed wheat and oats twice a day at the beginning of the fattening period, gradually changing to corn.

No. 47—Washington Experiment Station Rations

I—BREEDING STOCK—
1—Give corn, wheat, oats, and clover or alfalfa, using less corn than of other grains. The following may be given as a wet mash: Corn meal 1 part (by measure), bran 2 parts, chopped onion, or raw apples, or cooked mashed carrots or potatoes, 1 part, meat scrap or clabbered milk 1 part; mix with boiling water and steam before feeding. Or if it is desired to use a dry mash give: bran 8 parts, meat scrap 1 part.

II—FOR YOUNG TURKEYS—
1—One hard-boiled egg for every eight poults added to stale (not sour or moldy) wheat bread dipped in milk and squeezed dry. Feed for about two weeks. The egg may be alternated with cottage cheese. Then substitute best meat scrap for the egg, and keep clabbered milk before them.
2—One raw egg for every eight poults, added to a a pint of bran and enough clabbered milk to mix rather dry. After two weeks gradually substitute chick feed.

III—FOR FATTENING—
1—Feed grain—principally corn—night and morning; feed sparingly for the first ten days, then increase gradually to all they will eat.
2—To make plump, white-meated turkeys. Give equal parts of ground oats, ground barley, and coarse corn meal, mixed with table scraps, boiled carrots, and potatoes, and milk.
3—Ground oats moistened with milk, and a little mutton fat added every other day.
4—Equal parts of corn meal and ground barley, mixed with boiled potatoes or rutabagas.

NEARING THE FINISH
Turkeys being driven to market in the fall.

The profit in growing turkeys for market is almost entirely in the feed they secure by foraging. Even at the high prices which turkeys have commanded in recent years it is doubtful whether money could be made anywhere growing turkeys for the table on purchased feed, or on grain from the corncribs and granaries on farms. Some harvested feeds must be used in starting the young turkeys, but the quantity of these is insignificant. Some feed must also be given to finish for market, but this need not be a large part of what produced the meat. The policy of those who grow turkeys for profit must be to have them get the most of their living by foraging, and this result is secured by keeping the size of the flock down to what the range will carry. Overstocking has the effect of either making the turkeys remain much nearer the farm buildings where they and other poultry are fed, or causing them to wander far in search of feed. They may hang around home for a time, and then take a notion to look up new and better pastures, and they are apt to do this just when the attendant has concluded that they have settled down to a quiet life, and is proceeding with other work on the theory that, for the time, the turkeys need no watching.

Several broods of turkey poults generally combine in one flock and, as turkeys are usually kept, all the birds are likely to go in one flock. But where there is room and they are allowed to do so, a stock will frequently remain divided into small groups all season, each of these following a different route in foraging. It is the natural habit of a flock of turkeys, when foraging, to make a circuit that will bring them home toward evening. They

do not invariably make the same round, but are apt to do so. Fences and walls make no bar to their progress, for they go over them easily. It is their custom to make stops in shady or secluded places along their circuit to rest, and anyone knowing the "stations" on their route can tell very nearly the time of day when they will be found at each. In rainy weather which interferes with foraging as they travel the circuit they are apt to go quickly from station to station, but remain a long time at each, with the result that they get little feed. Careful turkey raisers make a practice of looking up the turkeys at their stations at such times and feeding them at these places as many times during a bad day as is necessary to insure that they will have all the feed they need.

Trouble is sometimes experienced in feeding new corn to turkeys when fattening them. It is always better to feed old dry corn if it is available; but if new corn must be used, it should be fed light at first, and the quantity increased as the birds become accustomed to it. When this is done new corn may be used with safety.

Peafowl may be treated exactly as turkeys are, with the difference that as they are not grown for the table they have no need of fattening rations, and corn is not as essential a part of their diet. If they are kept as most peafowl are, in small numbers where they can have liberty, they really need no more feeding than is necessary to keep them from going into yards occupied by other poultry, or from mingling with the other stock. This separation is not for the benefit of the peafowls, but for the protection of the other birds.

Guineas are given practically the same feed as turkeys, except that corn is usually given them cracked instead of whole. While they forage more widely than chickens they do not go as far as turkeys, nor are they as systematic in their habits. They are apt to keep near enough to home to be within hearing distance when the fowls and chickens are fed, and to rush in for their share, even though they have formed the habit of roosting out and are shy about being handled in any way.

Guineas as marketed are usually in poor flesh, or at best only fairly fleshed, but from time to time a few nice fat guineas may be seen in the markets. Where the thin guinea when plucked appears unattractive, fat guineas properly displayed will attract favorable attention at once. Whether it would pay the grower of guineas to fatten before marketing probably depends upon the circumstances under which they are grown, and the opportunity to sell them at a premium over ordinary stock. The few fat guineas that are seen in the market are probably birds of unusually docile disposition that have been reared and fed with chickens, or birds that have had some other exceptionally favorable conditions of growth.

Pheasants—The older authorities on pheasant feeding mostly recommended the use of "custards", ant eggs, maggots, and other things difficult of preparation; and also place much emphasis on the feeding of a greater variety of high-priced seeds than is put in feeds for chickens. The most successful pheasant growers in America have generally discarded all such special and expensive feeds as not only too costly and troublesome, but as actually inferior to a good ration for young chickens and turkeys. A thing to be especially sought in handling pheasants is a secluded place where they will be safe from things that would frighten them. While some pheasants are tame and not easily frightened, the average pheasant is more shy and nervous than the most flighty of our varieties of fowls. Birds of any kind that are easily frightened and are often frightened are never thrifty; the reaction of the fright upon the digestive system prevents proper digestion and assimilation of feed.

BRONZE TURKEYS ON THE FARM
Scene on Farm of Chas. McClave, New London, Ohio.

CHAPTER XI

Feeding and Fattening Ducks

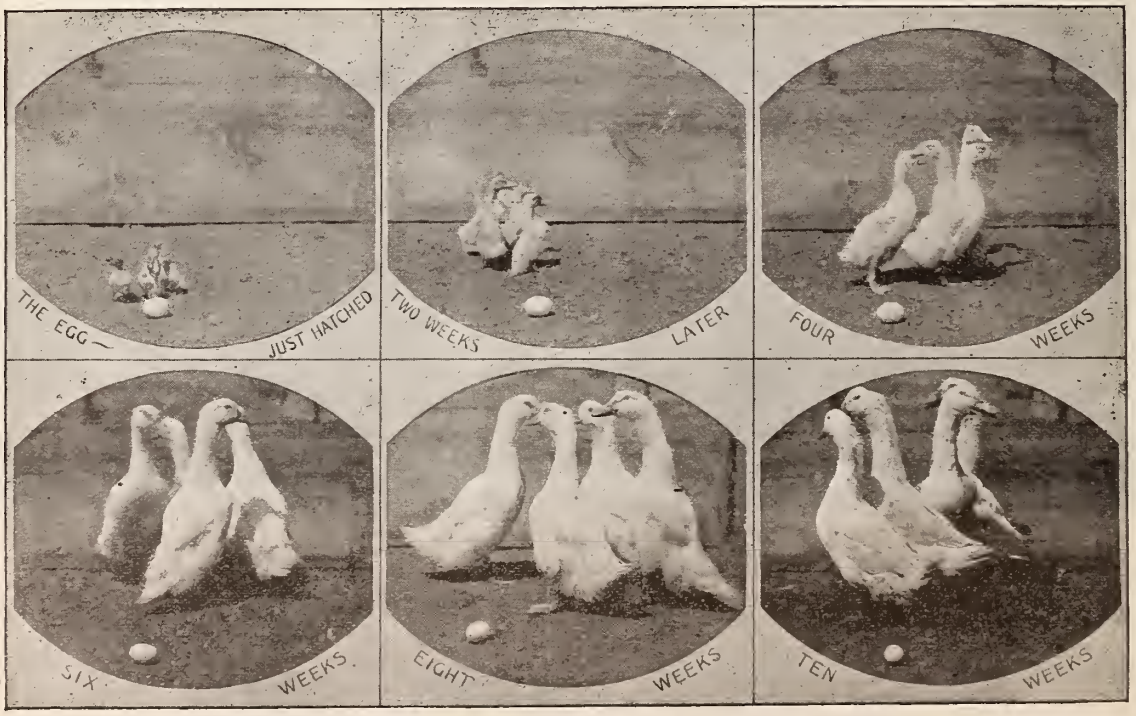
Special Features of Feeding Practice Due to Aquatic Habits of Ducks and to Their Remarkable Adaptability to Forced Feeding—Rations Used By Pioneer and Leading Commerical Duck Growers — Rate of Growth of Ducks—Feeding Young Ducks Designed for Breeders for Development and Breeding Stock for Egg Production

DUCK culture in America is principally the growing of ducks to be sold for the table at about ten weeks of age. There are few breeders of standard ducks for exhibition. Perhaps one farmer in ten keeps a few indifferently bred ducks with other poultry, and feeds them the same way, except as the ducks make their ration different by the things they get in foraging. Occasionally a poultry keeper with a preference for ducks keeps quite a large flock of them and sells the eggs for table use. In general, those who keep just a few ducks get poor results from them because they do not realize that a system of feeding which would be ruinous to any other kind of poultry is what is required to get the best a duck is capable of doing.

In all discussions of the making and use of moist mashes for land birds, emphasis is placed, over and over, on the importance of avoiding sloppy feed, and the necessity for using hard grain in larger proportions than the soft feeds given, if the birds are to be kept in good physical condition for any length of time. In expert feeding of ducks, hard grain is not used at all for the young birds while growing, and the breeding stock is given only a light feed of grain once a day. All the rest of the feed is in the form of mash, and the wet mash is used almost exclusively, because the conditions under which the birds are fed and the method of feeding do not admit of giving the ground feeds in the dry state. Ducks can be raised on dry feed, and will do well with it, but—as they want a great deal of water to wash a moist mash down when eating it, there is no object in giving it dry.

Moist mashes as prepared for ducks, are usually mixed about as dry as a moist mash can be, but the advantage of this is in the handling of the mash in distributing it, and in the fact that the feeding troughs keep much cleaner if the mash is so dry that it will not stick to them. Frequently poultry keepers raising a few ducks make the mashes for them very thin and sloppy—about like the feed used for chickens in crate feeding—and the ducks seem to thrive as well on them as on anything.

In feeding ducks, water must always be accessible to them while eating, for unless supplied with water to wash down the feed they eat only sparingly—not enough for good growth or egg production. The feed trough and the pail or trough of water should not be so close together that the birds can easily reach from one to the other, as under such conditions they slop badly and waste a great deal of feed. But if the water is just far enough from the feed so that the bird cannot turn to it with a mouthful of feed and swill the feed in the water it will partly swallow the feed, or swallow as much as it can, before going for a drink. Then when it goes back to the feed the drip from its bill falls near the water vessel and not in the feed as it will if the feed and water are too close together. With small flocks of ducks the slopping and waste from having feed and water too close together are insignificant, but when there are fifty or more ducklings in a flock, or ten or twelve breeding ducks, the waste becomes important and the work of keeping feed and water receptacles and the floors about them clean is much increased.



SIX PHOTOGRAPHS SHOWING THE RATE OF GROWTH OF DUCKLINGS

The young ducks in brooder houses are usually given water in drinking fountains of the inverted-cup type. As they grow larger the water is put in pails or troughs of such size and construction that the birds can drink and can get their heads and necks well into the water but cannot get into it bodily and foul it with their droppings. Where a few ducklings are raised with hens it is best to give them water in a pan that they can get in, and to rinse it out and give clean water with each feed. This will enable the little ducks to keep themselves free from any lice that may come to them from the hen. If the ducks are fed indoors and this results in too much wetting of the floor or of litter on it, the head lice—which are most troublesome when ducks are hatched and reared with hens—will be kept off if the water vessel is such that the duckling can get its head well under water.

When the breeding stock is confined to the house in winter, special care must be taken to keep the ducks from making the litter in a large part of the floor wet by their dabblings in the water and running about while wet. The usual plan is to have the water pail in a wooden frame about two and a half feet square, sunk into the floor until the top is only a little higher than the floor. This top is of slats with the edges up (strips of furring will answer) and with a space left in the middle into which the pail will go just deep enough to be firmly held in place. The floor under the frame is dug out as much as necessary to drain away all the water that is slopped out and comes through the slats. Where ducks have access to running or standing water in their yards or on range, it may not be necessary to provide water especially for drinking at feeding time. That depends on the amount and condition of the water, and its accessibility.

In feeding young ducks in brooders, or ducks with hens, if they have not an opportunity to eat growing tender green feed from the first, it is important to put a little coarse sand or fine grit in their mash. Some duck growers put sand or grit regularly in the mash for quite a long time, others use it only for a few days. It does not appear that there is any advantage in continuing it longer, nor is it necessary in all cases, though the impossibility of determining in advance which ducks need it and which do not, makes it the best policy for the novice in duck raising, or for all who do not observe symptoms of trouble as soon as they appear, to take no chances. In experimenting on this point the writer found that some ducklings would go off their feed unless given sand at the start, while others seemed to have no need of it, until he tried putting ducklings out for their first feed on grass (as we do goslings). From that time he found no occasion to put sand in feed for young ducks. One of the advantages of raising ducks, however, is that they will do better than any other kind of poultry where the natural conditions are not good, and probably the greater number of those who grow even a few ducks cannot start them on grass. The effect of lack of sand or grit in the feed is to make ducklings appear weak and listless, and indisposed to move or take any particular interest in anything. A little feed containing coarse sand or fine grit will revive them almost as soon as swallowed if given when the symptoms are first noted.

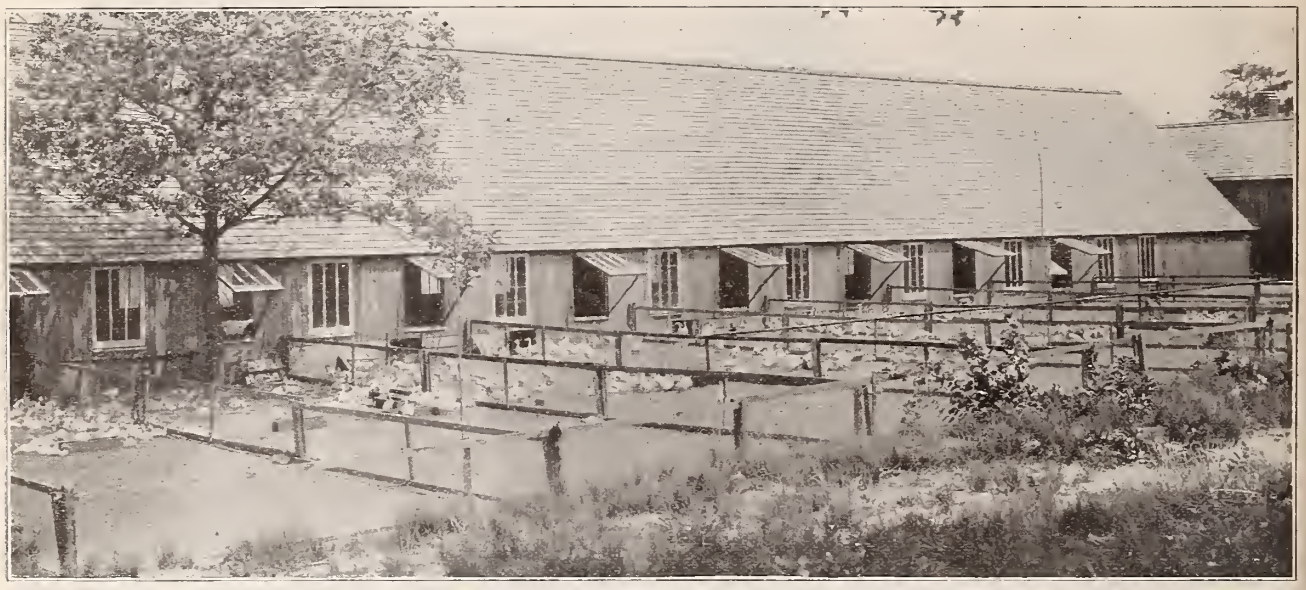
FEEDING TIME AT ATLANTIC DUCK FARM, SPEONK, L. I.

Another important particular in which ducks are unlike other poultry is their ability to digest, assimilate, and thrive remarkably upon rations having proportions of animal matter that would be highly injurious to chickens, turkeys, or geese. Ducklings can stand for some time meat scrap up to 30 per cent or more of their ration. It is not economical to feed it so heavily for any considerable period, but the ability of the duck to use strong feed makes it possible often to force growth very rapidly, and this is of great advantage both in bringing on ducklings that are a little backward as they approach the age for killing as green ducks, and in forcing lots to get them on the market as soon as possible when prices are declining.

While ducklings can use heavy rations containing large amounts of animal feed to advantage, they need liberal supplies of green feed. In fact, the use of large amounts of animal feed is necessary and profitable only when ducks are grown in confinement where they obtain little or nothing by foraging. When a few ducks are grown on good range, or are liberally supplied with green feed, they will grow quite as well as those grown on heavy

meat rations under the conditions which obtain on the commercial duck farm, though perhaps not quite as rapidly. In growing ducks for market, the profit is in the green duck, killed at from nine to eleven or twelve weeks of age. In growing a few ducks for the home table, a much meatier and larger duck can be obtained by keeping them until four or five months old. But to hold them profitably for the longer period they should be where they will pick much of their living, or where garden waste will make an important part of their diet. It will not pay to hold them so long and buy grain for them. Commercial duck growers also use large proportions of green feed in mashes, but rarely have enough of it to reduce appreciably the quantity of grain and meat needed to grow their ducks.

Large flocks of ducks kept for breeding can rarely be given a range that will supply any appreciable quantity of feed. Small flocks with good range either on grass



BROODER HOUSE FOR YOUNG DUCKLINGS

or on streams often pick the greater part of their living. The Indian Runner ducks are especially adapted to securing their living by foraging over meadows. The general tendency of foraging ducks is to work favorite localities quite thoroughly. The Indian Runner, as a result of living for many generations under conditions that made it necessary to forage systematically over considerable areas, has the habit of doing that established to a degree that enables it to get more than most ducks from the range on ordinary meadows.

The conditions in duck growing are such that the questions relating to feeding have been most thoroughly worked out on the commercial duck farms. Comparatively little has been done in this line at agricultural colleges and experiment stations, though the determination of the value of feeding meat to ducks in much larger amounts than had been customary was made at the Geneva (N. Y.) Experiment Station.

RATIONS FOR DUCKS

No. 48—James Rankin's Method of Feeding

I—FEEDING FOR BREEDING DUCKS—

Equal parts of corn meal, wheat bran, low-grade flour, about 10 per cent of meat scrap, and about one-fourth of the whole cooked vegetables—potatoes, turnips, etc. Feed this mixture mornings and evenings, a little more than the birds will eat up clean. After the ducks begin laying increase the amount of meat scrap to 12 or 15 per cent. At noon feed a little hard grain—corn, wheat, or oats, or a mixture of those grains.

II—FEED FOR YOUNG DUCKLINGS—

First four days, wheat bran, 4 parts; corn meal, 1 part; low-grade flour, 1 part; 5 per cent of fine grit. Feed four times a day, all they will eat up clean.

After the fourth day, wheat bran, 3 parts, corn meal, 1 part; low-grade flour, 1 part; 5 per cent of fine meat scraps and 3 per cent of fine grit. Feed four times a day. For green feed give finely cut green clover, rye, or cabbage.

When the ducks are three weeks old reduce to three feeds a day, and make the mash of equal parts of corn meal, wheat bran, and low-grade flour, 10 per cent of meat scraps, and 3 per cent of grit.

From six weeks old until the ducks are ready for market give the following: corn meal, 2 parts; bran, 1 part; low-grade flour, 1 part; 10 per cent meat scrap, and 3 per cent of grit.

No. 49—Weber Bros.' Method of Feeding

I—FOR BREEDING DUCKS—

Equal parts of corn meal and shorts, with 10 per cent of meat scrap added. If green feed is not available, add one-fifth of vegetables to the mash. Give raw vegetables at noon two or three times a week.

From the middle of November when put into the laying houses until the middle of December, feed equal parts of ground oats and shorts with about 5 per cent of meat scrap. Feed this morning and evening, and give green feed at noon. After the middle of December give a full laying ration of equal parts of corn meal and shorts, with about 10 per cent meat scrap added.

II—FOR YOUNG DUCKS—

Equal parts of corn meal, bran, low-grade flour, ground graham bread, rolled oats, 5 per cent of meat scrap, a little oyster shell, and fine grit, and a little finely cut green rye. Feed five times a day until the ducks are three weeks old.

After three weeks: corn meal, 2 parts; bran, 1 part; middlings, 1 part; 10 per cent of meat scrap, a little oyster shell and finely cut green stuff. This is fed until the ducks are six or seven weeks old, when the following ration should be given: corn meal, 3 parts; low-grade flour, 1 part; meat scraps, ¾ part; 3 per cent of oyster shell. When green stuff is available add 1 part to the mixture.

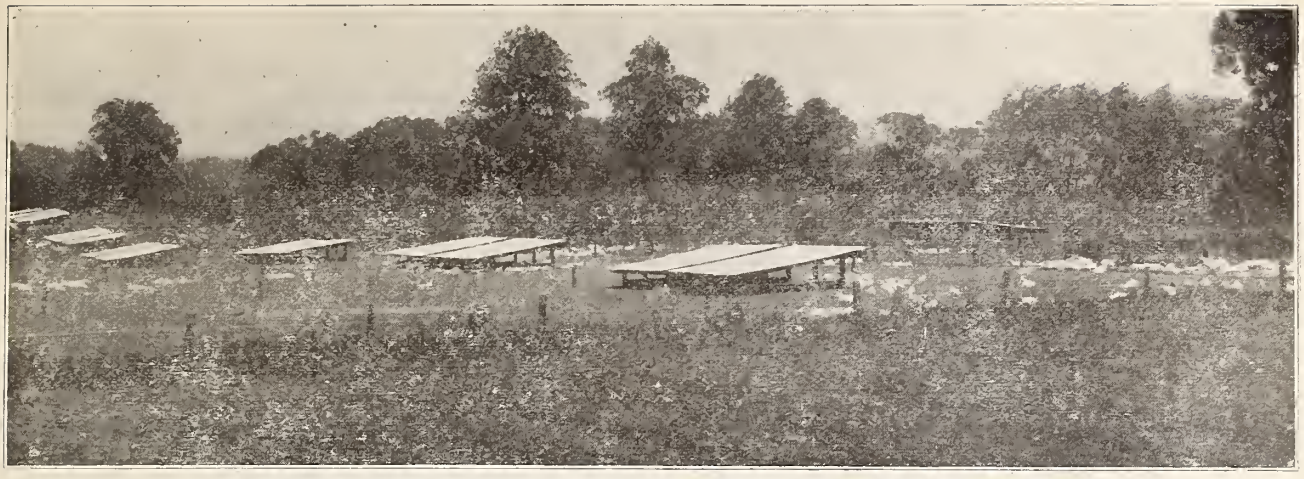
No. 50—A. J. Hallock's Method

I—FOR BREEDING DUCKS—

Corn meal, 4 parts; bran, 2 parts; middlings, 1 part; oats, 1 part; wheat, 1 part; mixed moist with about equal bulk of cut clover or other green feed

II—FOR YOUNG DUCKS—

First week: equal parts of corn meal, middlings, crackers or stale bread, and green stuff, with a small handful of sand to a quart of feed. Occasionally give stale bread soaked in milk for a change. Second week: corn meal, 4 parts; wheat bran, 2 parts; middlings, 2 parts; meat scrap, 1 part; sand, about one-third the quantity of green stuff. At about six weeks put ducks in fattening pens and feed the following: corn meal, 2 parts; bran, middlings, and greens—together—1 part; meat scrap, about 12 per cent.



SHELTERS USED FOR DUCKS DURING THE LATER PERIOD OF GROWING

Many other rations might be given, but they are all derived from and are substantially the same as the foregoing. Mr. Rankin was the pioneer of Pekin duck growers in America. The father of Mr. Hallock bred ducks for the New York market long before the introduction of the Pekin. Duck growing then was on a small scale. Mr. A. J. Hallock began with Pekins almost as soon as Mr. Rankin, and being a young man and more favorably located, developed his business on a much larger scale and became permanently a leader in the industry. The Weber Brothers began a few years after Mr. Hallock and, being neighbors of Mr. Rankin, got much of their early knowledge of the business from him. Nearly all the men who have made their mark in the growing of ducks for the table learned their business either on one of these farms, or from men who were trained on one of them.

It should be understood that all duck growers—and all expert poultrymen—vary their rations from time to time according to the availability and prices of different feeds. Corn meal, wheat bran, middlings, and low-grade flour are staple mill stuffs, supplies of which are practically always obtainable at as low prices as any other feeds could be bought. The practical duck grower uses these, with meat scrap and green feed, and adds to the mixture anything else in the milled-feed line that he can get at a satisfactory price. Duck growers generally use low-grade flour more than poultrymen who keep other kinds of poultry, because it is not practical to scald such large quantities of feed as they require, and the low-grade flour is not only the best thing to give adhesiveness to the mash, but adds much to its nutritiousness and palatability. Finely ground crackers and bakery waste give like results.

It will be noted that some of the duck rations present the unusual feature of hard grains mixed in the mash, and that in these cases there is not given the light feed of grain at noon, which is more common. Some poultry keepers who keep ducks for their eggs feed considerably more unground grain but give it mostly after soaking in water. Slightly sprouted oats are also a favorite feed for ducks. They can use a limited quantity of hard grain with the mashes or soaked grain given them, but any attempt to keep ducks on a ration with more than one light feed of whole or cracked grain a day will result in poor growth or poor production.

The feeding of the ducks on a large plant is always done as expeditiously as possible. Everything is arranged with a view to quick work from the moment the distribution of the feed begins until the last lot has been fed. Every available man takes a hand in the work, for as soon as feeding begins the ducks become quite excited, and it is always the experienced duck grower's policy to prevent excitement as far as possible, since the least excitement or disturbance that puts the large flocks of ducks in motion may result in the maiming of some of the ducks and may unfavorably affect the growth of many that are not crippled outright. The Pekin duck in particular is nervous and timid and, growing at the remarkable rate that it does, is even weaker than other ducks on its feet. Hence the grower takes every precaution not only against fright-

A FLOCK OF TEN-WEEKS-OLD DUCKS READY FOR MARKET

ening the ducks, but against their injuring one another in their eagerness to get at the feed.

The nervousness of ducks is much more in evidence when they are kept in yards without water runs than when they have water for swimming. In the yards where only drinking water is provided, the ducks are much quieter and pay much less attention to things that disturb them if the water supply is constant. This can be arranged either by having water piped to all houses and yards, with automatic faucets at each drinking place, or by having faucets at different convenient points on the plant where by opening a faucet for a definite short period at approximate intervals the supply of water in the vessels on a long line of pipe is replenished.

When the feed is distributed on a duck plant with horse and wagon, it is the usual practice to distribute it in wooden pails, placing these conveniently for the feeders all over the farm before feeding begins. The ducks do not associate the appearance of the horse and wagon loaded with pails with the feeding and pay no attention to it. The feed having been thus distributed, at a signal all the feeders begin and put it in the troughs as quickly and as quietly as possible. In the brooder houses where the youngest ducks are fed the work is done rather more leisurely and with a little closer attention to giving the ducks only what they will clean up promptly. With the flocks that are older and are not fed so often it does not matter if a little is left after the first rush for feed. The birds will soon come back and clean it up, and the all-important thing is that they shall all have enough to keep them feeling comfortable until the next meal.

On many duck farms the feed is distributed from a car running on a track built over the fences. This can be done because the fences need not be over two feet in height, and are sometimes lower than that. When the feed is distributed in this way the feeder uses a shovel, and as he pushes the car ahead of him throws the mash to wide troughs in each pen, placed at the right distance from the track. In this way the feeding can be done very rapidly.

Rate of Growth of Ducks

Remarkable as is the growth of an average chicken, it is slow compared to that of a Pekin, Aylesbury or Rouen duck. The combined standard weight of a Pekin duck and drake at maturity is just the same as the combined standard weight of a Plymouth Rock cock and hen. The duckling at hatching weighs about the same as an average Rock chicken. At ten weeks old the duckling is ready for market, not as a small broiler, but at a weight of six to seven pounds. The rate of growth for a lot of Pekin ducklings on a New England duck farm that were weighed at intervals of two weeks, was as follows:

Weight at hatching	1½ ounces
Weight at two weeks	14 ounces
Weight at four weeks	2 pounds
Weight at six weeks	4⅛ pounds
Weight at eight weeks	5½ pounds
Weight at ten weeks	7½ pounds

Comparing these figures with the data on the rate of growth of chickens given in Chapter VI, the reader will see that the average Pekin duck is heavier at ten weeks than the average Plymouth Rock cockerel at twenty-four, and heavier at eight weeks than the average Plymouth Rock pullet at twenty weeks. The green duck when marketed in this stage is quite fat. After about the twelfth week the duck begins to molt its "chick feathers" and grow its adult plumage, and if held until the new coat is coming strong it is not only hard to dress, but actually loses weight, and cannot be again put in marketable condition until after it is full grown.

Feeding Ducklings for Stock Birds

Commerical duck growers select their breeding birds from their general stock of young ducks when putting them into the fattening pens. Up to that time the same rations and conditions are suitable for all. As a rule, no ducks for breeders are taken from the earliest hatches, for these are not likely to be the best birds of the season, and they would have to be carried too long before they were needed. The common practice is to select the most of the birds to be kept for breeding from certain hatches which are conspicuously good, during May or June. These ducks, kept for stock purposes, are given the same ration that they had from three to six weeks until full grown. As soon as possible after selection they are put in more roomy quarters than are allotted those in preparation for market. Special attention is given to supplying them well with green feed. On the farms that have limited water range the best of this is given to the stock, old and young, that will be used for breeding the next season.

The object is to secure the full development of bone and muscle, and make birds of full standard weight when carrying a moderate amount of fat. The duck in this condition is right for breeding, and also as good as can be for exhibition. The practice of some exhibitors of making ducks very fat before showing them, giving them extraordinary weight and apparent size is detrimental to the birds. It is the ducks so treated that shrink so much in weight when shown. A well-fleshed specimen will not make any extraordinary shrinkage unless conditions attending its exhibition are uncommonly bad.

FRANCES ELLEN WHEELER FEEDING A FLOCK OF HER PEKIN DUCKS

CHAPTER XII

Feeding and Fattening Geese

Influence of the Grazing Habit of Geese Upon Feeding Practice—Starting the Goslings With Hens On Grass—Handling Large Flocks—Rate of Growth of Goslings—Methods and Rations Used On Commercial Goose Fattening Plants—Relation of Feeding Methods to Profits in Common Practice

NO one can really appreciate the value of green feed for all kinds of poultry until he has had a little experience in growing geese—and has grown good geese quickly. Geese are as fast growing as ducks, and they can be grown almost entirely upon green feed. They do better with a little grain feed. They grow quicker, larger, and carry a little more fat as they arrive at marketable age if they have one or two light feeds of ground grain daily; but their prime need is for pasture in summer, and for liberal supplies of vegetable feed with a moderate grain ration in winter.

The novice in growing geese usually—and quite naturally—supposes that the goslings should be fed about the same as young ducks. He waits the conventional twenty-four to thirty-six hours before giving them anything—to insure that they will not be hurt by feeding too early—and then feeds them a substantial meal of mash of some kind. If they do not seem to feel right after being filled up with this, he puts a liberal amount of sand or grit in their next soft feed. That helps, but in general those who try to grow goslings with a heavy grain diet have a great deal of trouble with them and lose many. If it is understood that the goose is a GRAZING BIRD, and that all kinds of poultry want the vegetable feed they eat very succulent and tender, the requirements in feeding geese are much more readily apprehended. They like to have access to the water, but do not get nearly as much of their natural feed from it as ducks. They prefer marshy land to clear water, because it affords them plenty of succulent grass and weeds, with enough animal feed of various kinds to give variety to the ration; but the goslings can be grown on dry pastures with only water for drinking, if the flock and the pasturage are so managed that the grass is never allowed to become hard and tough.

Starting the Goslings Right

Most goslings are hatched with hens, especially in the early part of the season when, if the geese are not allowed to sit, they will lay many more eggs. The common hen can brood only about half-a-dozen goslings at the start and these quickly grow so large that they have no further need of her services. A hen with a brood of goslings should have such a shelter coop as would be given her with a brood of chicks; but instead of such a run as is usually attached to a coop for chickens, the goslings should have a pen of boards or of narrow poultry netting. A board eight or ten inches high will keep them in. The pen should be about 6 ft. square, or as much larger as is convenient, and should be placed where there is a good growth of short, tender grass and weeds. Where only a few goslings are grown, it is a good plan to use wire covered runs such as are used for other young poultry when they must be protected from cats; then the goslings need not be confined to the brood coop at night and can eat grass at will. With large lots of goslings this is not practical because they need protection for so short a time that the cost of providing a lot of such runs and the labor of putting them out and putting them away would be out of all proportion to the benefit of giving the goslings the opportunity to feed at night while small.

The hen with her brood of goslings should be put in the coop with a run or pen confining the goslings to a little plot of grass near it, as soon as the goslings are dry. Those that hatched first will usually begin to nibble the grass a little as soon as put out. The hen should be fed two or three times a day what mash she will eat up clean when the goslings are eating with her. If there is grass enough available so that the goslings can always have all the green feed they will eat while growing, it is best to give the hen only two feeds of mash a day, and give one feed of whole or cracked grain. The goslings may have as much of any feed that is given the hen as they can eat while she is eating what she will take readily at one time. They like mash much better than hard grain, but will eat some of the latter. If the supply of green feed is not going to be ample, and must be conserved to make it last, the hen and goslings should have three feeds of mash a day, for as long as the hen stays with them. Any mash that is good for the hen will do

A FLOCK OF WATERFOWL ON POULTRY PLANT AT WISCONSIN UNIVERSITY

for the goslings, but the feeder should use care to feed only what will be eaten up at once, for goslings are like other creatures in their tendency to eat the most of things that are easy to fill up on, and if they have mash lying by them will not eat so much green feed.

As soon as the grass in the enclosure is eaten short, or becomes soiled so that the goslings do not care for it,

TOULOUSE GOSLINGS THREE WEEKS OLD

the coop should be moved. A coop 6 ft. square with half-a-dozen young goslings in it, on average good lawn, will need moving daily after the second or third day, and soon will need moving twice a day. Then a larger yard should be provided. When the goslings must be confined to the brood coop at night, it should be opened as early as possible in the morning, and not closed until the attendant is about to retire for the night. Growing them well on mostly green feed is a matter of giving them opportunity to fill up with it at frequent intervals through as much as possible of the twenty-four hours. After they are large enough to have yards instead of small pens the method of handling them varies. A few goslings may be given the run of a yard or pasture large enough to afford them feed until grown, but large flocks are more economically handled by confining them to a part of the range until that is eaten clean.

Growing Large Flocks of Geese

Those who specialize in growing geese plan to have a considerable number of hens hatching at the same time. Then instead of putting the goslings out in single broods at the start, they either place several hens in their brood coops so that while the hens are confined to these coops the goslings from all will have the same pen; or they take the hens away entirely, keep the goslings in lots of two or three dozen in pens on the grass during the day, and at night put them in coops or boxes in lots of twelve or so, and put these under a shed or other convenient cover. Many growers say they would rather do this for the short time it is necessary than bother with the hens. The goslings are fed several times a day upon such mashes as the growers are using for other poultry or find convenient. Where they have plenty of clean green feed, mashes are often used with no apparent bad results that, if given to goslings with limited supplies of green feed, would make them sick. In some places where geese are extensively grown on pasture, all kinds of mashes from nearly dry to sloppy, from heavy to light, and from sweet to sour are used—some growers being very careless in the matter of taking up remainders or sloppy mashes, yet in general one grower's geese appear as good as another's.

After a week or ten days, according to the weather and the season, the entire lot of goslings near the same age is put together in a grass field and a low fence of wire netting run across the field to confine the goslings to a strip a few rods wide until that has been eaten short. Then another fence is placed a few rods farther on, making a yard of about equal width with the first; when the grass in that is eaten off, the first fence is put a suitable distance beyond the second—and so on until the goslings have grazed the whole field. By that time the grass on the strip first occupied will have grown again, and the goslings are taken back to it and started over again. This system, of course, is applied with modifications to suit different circumstances. Early in the season when the goslings require some shelter they may be yarded where they can be driven at night to some permanently located out-building, or suitable shelters may be given them in the fields. But after the goslings are about three weeks old, and the baby down is replaced by the thicker, tougher coat of down which is under the feathers of the bird in full plumage, it takes something unusual in the way of a storm to drive a gosling under cover, nor do they need much shelter from the sun except in very hot weather.

Many of the goslings grown in this way get no grain after the first few weeks, and most of those fed some grain get only enough to make a good growth of frame. The grain fed is usually a mash or a little scalded cracked corn. The goslings grown in this way are not fit for market, and in general the growers take no interest in fattening them, preferring to take what they can get for them in a state to which they can be brought with little cost. Goslings that are to be used for stock birds are usually fed the same as the old geese after they are about half grown. While this is common practice and the most convenient way when small stocks are concerned, better stock birds will be obtained if young birds run by themselves and are given a little more grain while growing.

Rate of Growth of Goslings

Goslings grow at about the same rate as ducks; that is, the goslings of breeds of large size, such as Toulouse, Emden, African, and crosses and grades of these, will usually weigh about double (rather more) as much as

GOSLINGS IN THE ABOVE PICTURE AT 9 WEEKS OLD

ducklings of the Pekin, Rouen, and Aylesbury breeds at corresponding ages. Mongrel common geese, like "puddle ducks", grow more slowly. Also, to make full and rapid growth on this scale goslings must have a fair allowance of grain. The goslings that are reared almost entirely on grass will not do it except where a few are grown together and the pasture is uncommonly good.

They may have the frame and muscle, but will not have the fat to bring them up to full weight. And, as a rule, they will be from ten to fifteen per cent smaller than they would have been with one or two light feeds of mash a day.

Large goslings weigh about three to three and a half ounces when hatched. At one month they should

GOSLINGS GRAZING

weigh from four to five pounds, and from that time until ten weeks old should make a gain of over one pound a week—a little more at first, gradually increasing until at the last of the period they are putting on as much as a pound and a half a week. At this rate goslings weigh from 10 to 12 or 13 pounds (and occasionally even more) at ten weeks of age. A gosling to be sold as a green goose is usually at its best for that purpose at ten to eleven weeks. Sometimes they will continue to grow for a little longer, but as they are usually coming to this age in June and July, they are more apt to go back a little than to gain if the weather becomes hot. As the earliest goslings bring the best prices, and the tendency is for the price to run a little lower as the season passes, it is nearly always the best policy for the grower of green geese to sell them as they are at ten or eleven weeks. If held longer they may not only begin to go back in weight, but will certainly begin to molt their first plumage and grow their adult coat, and while they continue to increase some in size while this is going on, the rate of growth is not as rapid as before, they are not as fat as it is desirable to have them to command the best prices, and being full of pinfeathers they are hard to pick, and do not make as nice an appearance when dressed.

Fattening Goslings

Goslings that are grown to be marketed as green geese at ten to twelve weeks of age can be made as fat as necessary by simply giving them all they want of an ordinary mash for growing chickens, for a week or ten days before they are to be sold. Few goslings are finished in this way, because so few of those who grow goslings produce them in any considerable numbers, or are willing to give them any extra care and feeding. Goose growing generally is a matter of getting what is possible from a few dozen, or at the most a few hundred goslings, without expense for feed. The greater part of the goslings grown each year are either sold to men in districts where geese are grown on many farms, who make a business of fattening for the market, or go into the markets of the large cities with the general receipts of poultry, and there are picked up in quantities by commercial fatteners, or in small lots by immigrants from Central Europe who fatten them for their own tables. The commercial fattening of geese is done by substantially the same methods as market ducks are handled in the last few weeks before killing. The principal differences are in the "conditioning" of the geese before the beginning of heavy feeding, and the more exclusive use of corn in fattening. The geese brought to a goose-fattening farm to be finished for market, being collected from hundreds of different places, sometimes transported long distances, and mostly accustomed to a diet containing comparatively little grain in any form, cannot be immediately put on a heavy fattening diet. To do so would be to spoil the digestion and make it impossible to finish them for market. Especially in fattening the earliest goslings in hot weather it is necessary carefully to avoid anything that would put them "off their feed."

A goose farm that fattens through the season, from as early as goslings can be secured for this purpose until the beginning of winter, is usually located where ponds or streams will afford the geese ample opportunity for exercise in the water. When the geese are first brought to the farm they are put in yards that give them access to the water, and fed rather sparingly twice a day a mash of corn meal and bran and middlings, in which the corn meal is about half of the mixture, and the other half is equal parts of the other two ingredients. There is considerable diversity in practice in this respect however, and some fatteners use much larger proportions of corn meal from the start.

Green feed is given liberally. As the first geese do not come to the farm until July, and as the land on which geese are fattened soon becomes quite fertile, it is an easy matter to have rank crops of oats, barley, or fodder corn growing at this season, which will supply all the green feed needed for some time. With plenty of green feed, two light feeds of grain a day, and freedom of the water, the geese are soon in excellent condition and ready for a heavy fattening ration. They are now taken from the yards affording them access to water for swimming,

GOSLINGS DRINKING

leaving these for the newcomers, and are placed in pens a few rods wide, and either nearly square or about twice as long as they are wide. The arrangement and size of the pens is determined mostly by the lay of the land and convenience in feeding. In these pens are long troughs for water and feed.

The fattening ration may be much heavier than what the geese have previously received, containing a larger proportion of corn meal with some meat scrap, or the birds may at first be fed only more freely of the lighter ration they have had up to this time, and perhaps given three feeds of it a day instead of two. The composition of the ration, the frequency of feeding, and the liberal

COOK HOUSE AT AUSTIN'S GOOSE FATTENING FARM, MANSFIELD, MASSACHUSETTS

or sparing use of green feed, are all matters to be determined in each case by the feeder's judgment of what the birds can stand, by the importance of haste in finishing them, and by the available supplies of green feed.

The plants are not usually large, and the profitableness of operating them depends much upon putting as many geese as possible through the process. To insure supplies of geese the fattener must contract ahead for deliveries at certain times, and the earlier receipts must be got out of the way to make room for others as they come along. With each lot the grower has to consider how to get it ready for market as quickly as possible, but always with due consideration of the fact that if he overfeeds a lot in the early stage of fattening it may delay getting them properly fatted, and may also bring heavy losses. So he gives always as heavy a ration as he thinks the birds can stand for the period required to make them as fat as desired, and in view of the importance of green feed in conditioning new lots as they arrive. and the frequent difficulty of securing full supplies for the latest arrivals, the fattener usually gives the birds that are getting a heavy fattening ration as little green feed as he can, and not have them break down. Sometimes the birds get none for several weeks at the finish.

The feeding on a goose-fattening farm is usually going on continuously from daybreak until after dark. Each pen is fed only twice, or at most three times a day, and as mixing and giving the feed constitute practically the whole of the day's routine for most of the men employed on a large plant, the number of men kept is just enough to do the work by beginning the second feeding immediately after the first is completed, and the third immediately after the second. This can be done better with geese than with Pekin ducks because they are not shy, nervous, and excitable, and are not so uneasy when others are being fed while they wait. Feeding in this way the goose fattener does not attempt to feed only what the birds will clean up quickly, but feeds liberally, his only care being to avoid giving more than will be eaten within an hour or two after feeding.

AVERAGE RATIONS FOR GEESE AS USED BY SUCCESSFUL GROWERS

No. 51—The Little Compton Method

I—FOR BREEDING GEESE—

Turn out on pasture from June until fall, feed no grain while grass is available, then feed lightly of oats and whole corn. After February 1st give a mixture of corn meal, shorts, meat scrap, boiled potatoes, and turnips in the morning; whole grain in the afternoon.

II—FOR GOSLINGS—

Pen the birds on tender grass and feed a mash of corn meal and shorts two or three times a day until about three weeks old, then put in larger pasture and give a light feed of mash twice a day, with occasionally a little cracked corn.

No. 52—C. F. Newman's Method

I—FOR BREEDING GEESE—

They must have a pasture where from early spring they will live almost exclusively on grass, clover, and green rye. Place some oats and barley in boxes about eight inches square, where the geese can get to them in the pastures, but away from other poultry. Give corn only in the coldest weather, or when there is snow on the ground, preventing the geese from foraging.

II—FOR GOSLINGS—

The first two or three days keep them in a warm place and give them only soaked bread and water. In nice weather put them on grass in small enclosures that can be moved every day. After a week let them run. The first four or five weeks give nothing but an occasional feed of stale bread. Do not soak this after the first few days, as they like it better dry, if they have plenty of green feed. After five weeks give a mash of 2 parts of bran and 1 part of corn meal instead of the bread.

III—TO FATTEN GOSLINGS—

After six weeks feed corn meal and bran, equal parts, in a moist (but not sloppy) mash.

No. 53—W. H. Rudd's Method

I—FOR BREEDING GEESE—

Adult geese should be turned out to pasture the same as cattle, and should obtain their own living about six months in the year. Through the early laying and breeding season they should be fed twice a day with shorts (bran and middlings) and corn meal, equal parts, moistened with water. If stale bread can be had at reasonable prices, soak it and use instead of shorts. Add 10 per cent of meat scrap, or its equivalent of other animal feed. Supply shell liberally.

II—FOR GOSLINGS—

Feed at first a mash of 1 part of corn meal and 2 parts of shorts. wet cold and squeezed as dry as possible. Give a little every few hours—as often as they appear hungry. As soon as the grass begins to grow put them in movable pens on the grass. When three or four weeks old, turn them out to pasture. The enclosure may be of any size, but should be so fenced that they cannot wander from it. With good pasture the mash may be 3 parts of shorts and 1 part of corn meal. Feed this twice a day—only as much as they will eat up clean. The drinking vessels should never be empty.

III—FOR FATTENING GOSLINGS—

Confine them more closely and feed less shorts and more meal, adding some meat scrap; gradually increase the proportion of meal and meat scrap until the feed is about 90 per cent corn meal and 10 per cent meat scrap.

FEEDING MONGREL GEESE AT AUSTIN'S FARM

Relation of Feeding Methods to Profit

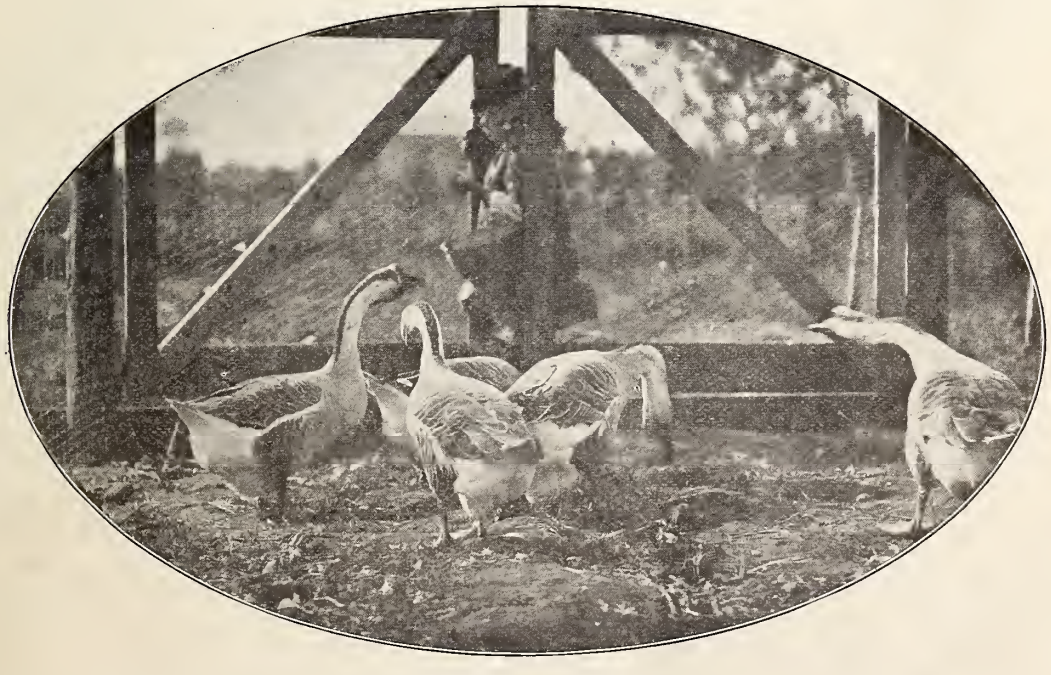
Throughout this chapter the greatest emphasis has been put on the liberal use of green feed, because the profit in growing geese—and the pleasure as well—de-

pends upon keeping them under such conditions that they secure the greater part of the feed they require by grazing. It is possible to grow geese on heavy grain rations. The risks and losses are greater and the cost usually too great, but it can be done; and there is little doubt that if it were profitable to grow geese on grain as ducks are grown, strains of geese could be developed by selection, generation after generation, of individuals that did best on such a diet. But the general run of geese are not adapted to heavy grain feeding, and it will usually be found that when they are so fed—even on a well-made mash, considerable quantities of it pass through them undigested. This will be the case even with thrifty birds that are making normal growth. Obviously they get all they need from the grain, provided they get it often enough, but their digestive organs appear to carry grain feed through the system too rapidly to admit of complete digestion.

The goose normally is not an efficient digester of grain. Its digestive system is adapted to the quick handling of bulky, easily digested material. Except when rations with too much corn meal are given to goslings at the start, it takes a great deal of abuse of the digestive system of a goose by heavy grain feeding to damage it seriously, for the goose has a rugged constitution, and the digestive organs apparently have more power than those of other poultry to discharge nutritious matter in excess of immediate requirements. The goose is not quickly cloyed by overfeeding, and if it is allowed to do so will eat much more grain than it requires and can use to advantage. For that reason goose growers who put their breeding geese out in pastures and keep a little grain by them, give oats and barley which are the least attractive grains.

Young geese penned on grass that affords them less green feed than they could use to advantage and are fed grain to make up the deficiency will almost always eat much more grain than it is economy to give them, if they are allowed to do so. To feed grain lightly in order to correct this does not answer the purpose, for the proportion digested is apparently about the same whether much or little is eaten at one time. It should be recognized that the average goose is only going to get a part of the nutriment in grain fed it—apparently as much as it can get from grain in the time it would take to digest tender vegetation. So while a little grain is at times beneficial, supplementing the green feed and giving better growth and better egg production, it really pays to feed grain only for what it will do over and above what can be done with all the green feed the birds can eat—that is, when the geese are grown for the table. In growing extra-large geese for exhibition, grain is fed more freely, for here the idea is to get the greatest possible growth regardless of cost.

The problem of supplying succulent feed to geese on limited areas becomes quite troublesome sometimes when more than two or three are kept, for it takes a lot of green feed to make a pound of goose. The birds are not fussy about what they eat and, while we think of grass as the principal feed to be obtained from pasture, geese really prefer many of the common weeds to grass. They are particularly fond of dandelions and other low-growing plants that come in grass, and where geese have access to grass land year after year in sufficient numbers, they will exterminate such weeds, while the grass will improve as long as it is not eaten down too close.



CHAPTER XIII

Growing Feed for Poultry

At Present Prices the Collectible Manure Made by a Single Medium-Sized Fowl is Worth Fully Fifty Cents a Year —The Poultry Keeper Should Always Plan to Have Enough Ground Under Cultivation to Utilize This Valuable Fertilizer—Green Feed for the Fowls Should Be Provided, if Nothing Else—What Crops to Plant and How to Grow Them Successfully

A BACK-YARD poultry keeper whose small flock occupies all the land he can use for poultry or planting is not interested in the question of growing feed for poultry; but to every poultry keeper who has more land than that the question is one of great importance. It is not merely a question of supplying feed for the birds—though that is a consideration. The root of the matter lies deeper. The droppings of poultry are a valuable fertilizer for plant growth, but under some conditions become noxious poison to poultry. Everyone who keeps fowls has to consider how to dispose of the droppings to the best advantage.

Many poultry keepers—far too many—are accustomed to treating the droppings as so much worthless refuse that must be got rid of with the least possible trouble and expense. Amazing as it may seem to those who know something of the fertilizing value of poultry manure, in districts where there is much intensive poultry keeping enormous quantities of hen manure are annually buried in public dumps with ashes and all kinds of refuse, or piled up in out-of-the-way spots on poultry farms, or perhaps used for grading and filling.

A part of this waste has sometimes seemed unavoidable. For instance, the land occupied by a certain market poultry plant upon which large stock of chickens had been grown for many years eventually became so saturated with poultry manure that the birds did not thrive on it. Other farms in the vicinity were in much the same state. The district was devoted to poultry to the exclusion of most other lines of agriculture; the people were poultrymen, but not farmers. There was no outlet for a surplus of manure within any convenient hauling distance, and hundreds of tons were dumped in a swamp at the rear of this farm, while in another part of the same state an isolated large poultry plant, in a general farming community, was getting $10.00 a ton, at the plant, for all the poultry manure saved from the droppings boards, and trading off the droppings mixed with litter for new straw litter, load for load.

There was a time, when there was not so much poultry kept and when poultry and pigeon manures were extensively used in tanning leather, when the clear manure was always salable at prices which realized as much as its fertilizer value. But that time passed nearly a quarter of a century ago. Since then there has been only a limited demand for poultry manure for other than fertilizing purposes, and this has been so irregular, and confined to so few localities that not one poultry keeper in a hundred could benefit by it. Getting value for poultry manure since the large demand for it for tanning purposes ceased has been a matter of using it to produce feed for poultry. Occasionally one might sell or trade it to advantage, but in general what the poultryman got from the manure was what he could get by using it himself.

A medium to small-sized fowl (the kind most common throughout the country) makes from 1½ to 2 bushels of manure a year. About half of this is always collectible. When hens are kept in small yards, or confined entirely to the house, it is practically all collectible, though the part not left on the droppings boards is usually much mixed with earth and litter, and its value further reduced by exposure to the air, sun, and rain. Making due allowance for some unavoidable waste, there is still the possibility of securing and using approximately three-fourths of the value of the fresh manure. This means that from a flock of ten birds about one-third of a ton of manure can be collected in a year. At the present time this should be worth at least five dollars, or fifty cents per bird.

To lose this value is not a serious thing to the owner of ten birds, but if the owner of a hundred birds loses in the same proportion it is fifty dollars, and if the owner of a flock of a thousand birds fails to realize the value in their manure, it means at least FIVE HUNDRED DOLLARS taken from his annual income. No one can afford to lose this. A poultry keeper who has more than a little back-yard flock ought always to have land enough to utilize all the manure his poultry make. It is a point of good management to adjust the amount of poultry kept to the land in this way.

In the smallest yards where poultry are kept and some feed grown for them, the feed should—as a rule—be some rank growing crop that rapidly utilizes the fertilizing elements in the manure. Rape is one of the best plants for small spaces, as it can be sown broadcast to occupy the ground fully, and by cutting the tops at intervals and feeding to the poultry it will continue growing, furnishing a regular supply of green feed, and taking up the manurial matter in the soil through the entire season. In planting and using rape in this way particular attention should be given to the physical condition of the land before the seed is put in. The common tendency of amateur gardeners is to rush the preparation of the land to get the seed in as quickly as possible. The experienced gardener does not put seed in the ground until it is properly and thoroughly fitted—forked or spaded as deep as the character of the soil will permit, well pulverized, and made smooth on the surface.

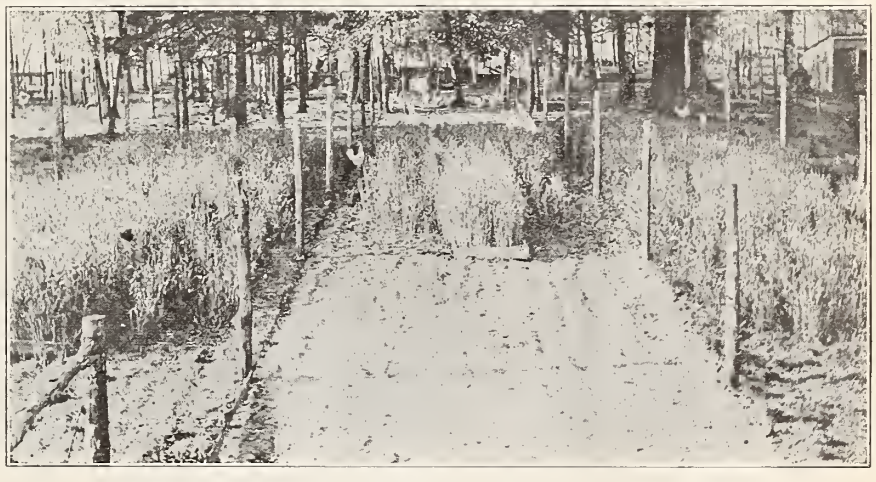
If this is not done, the soil but slightly stirred, left lumpy, and with the manure that had accumulated at or near the surface imperfectly mixed with the soil, the conditions of good growth are not realized, and the vegetable crop cannot do the service expected of it as quickly or as well as when the land is thoroughly fitted. Land that has not been cultivated for one or more seasons should be thoroughly worked over twice before seeding. Nothing that can be done to it pays better than the second spading. On plots that are large enough to warrant using hand plows, deep tillage and thorough preparation are secured by running each furrow twice—making a furrow and then coming back in it.

Where there is more land available, a succession of crops that can be cultivated as they grow may be planted. If the idea is to produce feed for poultry only, rape, chard, lettuce, cabbage, and mangel wurzel beets are the most satisfactory crops. In most cases it is desirable to grow some vegetables for the table as well as for the poultry, and where one or two pens of fowls are kept on an ordinary town lot there usually is land enough available for

planting to furnish all the vegetable feed the birds require, and a considerable amount of vegetables for the family table. It is simply a matter of intensive cultivation and good management.

In growing a variety of vegetables for poultry or for the family and the poultry, the aim should be to adjust everything to the principal crop or crops grown. For instance, if it is desired to have a supply of cabbage or mangels for the fowls for winter, as well as green feed of some kind through the summer, the winter supply should be considered the main thing and all plantings made accordingly. Cabbages for winter are usually set in July in the northern states, so a good crop of rape, chard, or lettuce may be taken from the same land before the cabbages are set out. Turnips are less desirable for poultry than the other vegetables mentioned because, as commonly grown, they often have a bitter flavor which is communicated to the eggs of fowls that eat them, and even when free from this, turnips that are only very slightly decayed and are eaten readily by poultry, may have a rank odor and give a disagreeable taste to the flesh or eggs of birds eating them. With these risks in the use of raw turnips it remains true that a crop can be started and matured later in the season than any other vegetable that will make winter feed, and that with care in feeding—and by cooking them if that is found necessary—turnips may be freely fed to poultry. The writer has known of their being fed as freely as mangels to large stocks of laying hens without affecting the flavor of the eggs.

In considering vegetable crops for poultry it should be observed that cabbages and the root crops occupy slightly different positions in the diet. Cabbage is both a green and a succulent feed. Except for the bleached inner leaves of the matured head, and for other parts after long storage, cabbages supply considerable of the material that gives color to egg yolks. Mangels apparently supply none of this. Yellow turnips may supply it, but observations on their use do not afford results warranting the statement that they materially affect yolk color. Cabbage as fed in winter does not give rich color to yolks but does relieve the extreme paleness that occurs when the diet contains little yellow corn, green-cured clover or alfalfa, or green sprouted oats. Hence a supply of cabbage may be considered as in part substituting for other common green feeds, and at the same time supplying succulence, while the root crops supply only succulence and such nutriment as is contained in their solids.



KEEP SOMETHING GROWING IN THE POULTRY RUNS WHENEVER POSSIBLE

Growing crops in the runs use up fertility that otherwise would be wasted, supply some green feed for the fowls, and afford grateful shade. Illustration shows oats growing in runs at Maryland Experiment Station.

Growing Mangels

The greatest obstacle to the growing of mangels is the uncertainty of germination of the seed, and the consequent difficulty of getting a good stand started early in the season. Unsatisfactory results from mangel seed are said by some seedsmen to be due to exposure of the seeds in storage or in stock to conditions under which the germs start and then die. It is said that a degree of moisture not detrimental to other seeds will often produce this result. The only way of determining the germinating quality of the seeds is by testing. While preliminary testing may be of some service, the difficulty is of such a nature that only results at actual time of planting prove the quality of the seed as used.

The difficulty of getting good stands of mangels has long been commonly explained on the theory that the seeds generally were low in vitality. On this supposition the best time to sow mangel seed is after settled warm weather comes. Authorities taking this view have been accustomed to recommend rather late sowing. The best crops of mangels the writer has seen in late years have been from early sowings. The poultrymen most regularly successful with them say that the best practice is to sow mangels as early as the ground can be properly worked; that if the seed is good it will germinate then as well as at any time, the crop will start well ahead of the weeds, will have a long growing season, and produce enormously; that if the seed is not good, another supply can be secured and the crop resown as soon as that fact is ascertained; that by this course there is an opportunity to replant several times if necessary before the time mostly recommended for this vegetable, and that the earlier a stand is established, the heavier will be the yield.

Poor germination seems to affect the larger varieties of beets most. For that reason, people who have had much trouble in getting good stands of the largest varieties often become discouraged and put in the smaller kinds of stock beets. That this is really their advantage may be doubted, for the roots of the "mammoth" varieties grow so much larger than the others that often what looks like a very poor stand of the big ones yields much more than a good stand of the smaller varieties, on a like area of the same land.

Mangels can be grown well on any friable soil that keeps reasonably moist through the season. The land should be ploughed deep, worked thoroughly fine, and put in the best possible physical condition before sowing the seed. Some of the most regularly successful growers of mangels say their practice is to harrow and smooth the land until it is as good as they would want it for ordinary garden, and then go over it several times more. They say that such extra work greatly benefits the plants at the start, and its influence continues through the whole growing season. With thorough cultivation, both before

sowing and as necessary afterward to keep the soil loose and the weeds down, mangels appreciate liberal application of manure. How freely poultry manure may be used for them depends upon the soil and whether it contains enough moisture to make such strong manure available for the plants without burning them in the early stages of growth. Generally it is not wise to use hen manure heavily for mangels on land that will not dry out quickly in case of a spring drought. On such lands it is better to use ordinary barnyard manure. Where, however, there is moisture enough to insure that the plants will not burn, hen manure can be used very liberally, especially if applied before ploughing and thoroughly worked in by harrowing.

Where the growing crop is to be cultivated by man power mangels should be sown in rows two feet apart, and when up well should be thinned to about 10 or 12

A FIELD OF MANGEL WURZELS GROWING FOR WINTER GREEN FEED

inches apart in the rows. If young beets can be used either for poultry or other stock it may be a good plan to thin to 5 or 6 inches apart the first time, then before the beets at this distance are crowding so that growth is reduced take out the intermediate ones. Many growers prefer to make one job of the thinning, considering the value of the small beets for use in summer not great enough to offset the check to those left through the season, if through press of other work they should fail to make the second thinning at the right time.

Where cultivation is with horse implements the rows of beets should be three to four feet apart, and the plants thinned to 12 to 15 inches apart in the row. Where the land is strong and capable of producing very large beets it will be found an advantage to give the plants plenty of room. Generally mangels do best with level cultivation, but on land that is a little wet early in the season it is sometimes a good plan to ridge the land slightly before planting, and sow the rows of beets on the ridges. This gives a little better conditions for the plants at the start and the ridges work down when the cultivator is run through them.

Growing Cabbage

While it is principally late cabbage, for winter use, that is grown for poultry, a supply of early and second-early cabbage to be taken from the ground as needed, often comes in handy for extra green feed in summer. In gardens worked with hand and small wheel hoes it is often practical to grow a considerable number of heads of early cabbage between the rows of crops of various kinds that do not at this season require the room they will need later. In such places cabbage plants may be set at the necessary distances to allow them to head properly—18 to 20 inches is right for most of the early varieties—or cabbage seed may be sown in a solid row, as when starting plants for transplanting, and the plants allowed to grow this way until they are wanted for feed. Those who follow this practice say that a small strip of land will provide more green feed from cabbage grown this way than from rape, chard or lettuce.

In the northern states plants for early cabbage must be started in hotbeds in February or March, transplanted to coldframes when they are two or three inches high, and grown in these until they can be set in the open ground in the spring. As a rule, it does not pay one who grows only small quantities of cabbage to try to start his own early plants. The trouble is only warranted when other plants are to be started under the same conditions. The young plants require close and careful attention, and if they do not get it will make poor growth later. In general, therefore, it proves more satisfactory to buy good thrifty plants in such numbers as are required. In the South early cabbage may be started in the open as late cabbage is in the North.

In growing early cabbage for poultry feed it is generally advisable to give plants a little more room than is allowed by market gardeners who force them to get the crop on the market as early as possible and all at the same time. The plants will take longer to head, but they will hold their large outer leaves better and, as they grow larger, make considerably more feed. The rows should be from 24 to 30 inches apart and the plants 18 inches apart in the row.

In the growing of cabbage for winter storage and use it is desirable to have the plants complete their full growth just as hard freezing sets in. If they reach full size too early in the fall many of the heads split, preparatory to starting a seed stalk. Though they are still useful as poultry feed, a larger proportion of the stalk becomes woody and inedible, thus increasing the waste, which when the cabbage is harvested at just the right stage is limited to the stump below the head. According to locality and the estimated rate of growth, main crop cabbages are set out from about the middle of June until the first of August.

The prime points in growing a good crop of cabbage are, good plants, heavy manuring, thorough cultivation of the land as long as tools can be used among the plants without too much breaking of the outer leaves, and a fairly liberal amount of moisture throughout the period of growth. The grower who buys his plants should take none but strong, thrifty looking plants, that have plainly not been stunted in the seedbed by crowding or for lack of moisture, or allowed to wilt while in the market. Those who grow their plants should select for the purpose a rich, quite moist plot upon which no cabbage has recently been grown, or manure used containing cabbage refuse.

The seed should be sown—not too thickly—in rows 10 to 12 inches apart. Seed should be sown to produce several times the number of plants required, thus giving a good selection when transplanting. The young plants should be cultivated enough to keep the soil loose and free from weeds.

Cabbages do best on strong but friable black soils, but with proper management and liberal applications of manure heavy crops can be grown on any soil that is in good tillage. To grow cabbage economically, however, the soil must be reasonably well suited to the crop.

The plot selected for the crop should be one not used for it the previous season. If the land carries a liberal amount of fertilizer from previous crops and is in a very good state of tillage, or if manure is available for a heavy application to the entire piece, it will be least work to put the manure on broadcast and plough under. On lands less heavily fertilized to begin with, better results may be obtained by furrowing deeply where the rows are to run, manuring in the furrows and turning the soil back into them before setting out the plants. For horse cultivation the rows should be from 3 to 4 feet apart, and the plants from 2 to 2½ feet apart in the rows. The best distances will depend upon the variety of cabbage used and the fertility of the land, and can be determined only by experience and knowledge of both.

Growing Turnips

The advantage of growing turnips for poultry is that a crop can be obtained from plantings made when it is too late to start beets or set out cabbage. The time for sowing rutabagas is about a month later than the latest date that mangels can be sown with expectation of a fair crop; the common varieties are sown still a month later—in the last of July, and in the latitude of southern New England turnips may be sown as late as the first of September, and give a good supply of small roots. Unlike mangels and cabbage, turnips are best grown on light soils and without fresh manures. The best land for them is land that is in good tillage and contains a moderate amount of old manure remaining from applications for previous crops. Rutabagas and the larger varieties of other turnips should have the rows 18 to 24 inches apart and be thinned to leave the plants 6 to 10 inches apart in the row, according to the variety and the time of planting. When planted too late to make full growth the plants can stand closer.

Growing Stock Carrots

Carrots are not often especially grown for poultry, but if one happens to have a piece of sour land upon which the other crops mentioned will not thrive, it will often be found that such a plot will grow a good crop of carrots. The earlier it is planted the better the crop will be. A fair to good crop is often obtained from sowings made as late as the early part of July. For these late sowings, however, the half-long and large stump-rooted carrots are preferable to the long stock carrots.

Carrots are usually sown in rows from 14 to 20 or more inches apart, according to size and season. On rich land they can be grown, if desired, without thinning. The roots will not be as large or as uniform in size as when thinned to a few inches apart, but the total weight of the crop is usually considerably greater.

Storing Vegetables for Poultry

As far as such space is available or can be provided, permanent cellars are best and most convenient for storing cabbage and roots for poultry. Barn cellars, special root cellars, and incubator cellars are equally satisfactory. The latter, of course, are available for this purpose only through the early part of the winter. For storage of cabbage in any considerable quantity in cellars, shelving should be provided upon which the heads as taken up with the roots can be spread in single layers. In large heaps in a cellar, cabbages are likely to heat and rot badly. Roots can be stored in cellars either in bins or in piles on the floor. They should never be stored with tops on, for the tops, if packed at all close, will heat and rot quickly and communicate the rot to the roots.

Outside pits for storing cabbage, and sometimes other roots, serve in emergencies; but the labor of making them, the trouble of taking stuff from them as wanted, and the larger proportion of waste in stuff so stored, make the cost of building a pit annually for a few years equal to that of a permanent root cellar of considerably more capacity, and immeasurably more convenient.

Growing Grain for Poultry

The question of growing grain for poultry is on a very different footing from that of growing vegetables. As a rule, the only way that one can be sure of having mangels and cabbage in quantity is to grow them. On most farms that carry large stocks of poultry the greater part of the grain used must be bought because there is neither land nor labor available to grow it. Even when land is available it is generally difficult to get the labor. Hence, in general, the question of growing grain for poultry is a question of using to advantage the manure not needed for vegetable crops, fruit or grassland, and the usual practice is to plant as much land to corn as can be conveniently taken care of, or as the available manure can be spread over. The average cornfield on a small farm devoted to poultry is probably under two acres. A great many are less than an acre. Occasionally on larger farms fields of four or five acres are planted. These corn plots are not always manured with collected manure. Frequently they are on land close to the poultry buildings and have only the fertilizer left on the land by the birds. The great advantage of planting corn in such places is that it affords shade for the poultry, can be grown on the same land indefinitely year after year, and in any medium-loose and well-drained soil will keep the land pure enough to prevent troubles due to contaminated soil.

The average yield of corn grown under either of the above conditions, cultivated as long as practical, and then used for range for fowls or chickens, is about 100 bushels to the acre. It is seldom under 60 or 70 bushels, and occasionally over 150. Instances have been reported of more than 200 bushels to the acre, but this was accomplished by careful spacing of the stalks in the rows and extremely high culture. Two or three acres at average yields provide a quantity of corn that materially contributes to the feed supply, while the stalks, cut in lengths, make good scratching litter.

Oats are often grown by poultrymen to provide straw for scratching litter, and incidentally for what grain the oats threshed by the birds on the poultry house floor supply. Oats, however, appear to be of much less interest to those limited for land than corn, for most poultry farms are on rather light land not especially suited to oats, and, besides, the poultry must be kept away from the oats while growing.

Millet is sometimes grown, like oats, for the straw and what grain it may contain. It is better adapted to light soils than oats, has a later season, and stands drought better.

Growing Green Rye For Poultry

Winter rye is probably the most widely adaptable and most effective crop for the purification of foul ground. It also affords supplies of green feed in open winters and in the early spring. It can be sown at any time that the ground can be worked, but to get the most benefit, both in cleaning the land and in supplies of green feed, it should be put in early in the fall so that it will be well established and cover the ground well before winter. Then poultry can feed on the rye as it stands, any time that the snow does not cover it, while it will be ready either to pasture or to cut for feed the first thing in the spring. Rye on poultry land should be sown rather more thickly than as ordinarily grown to make long straw.

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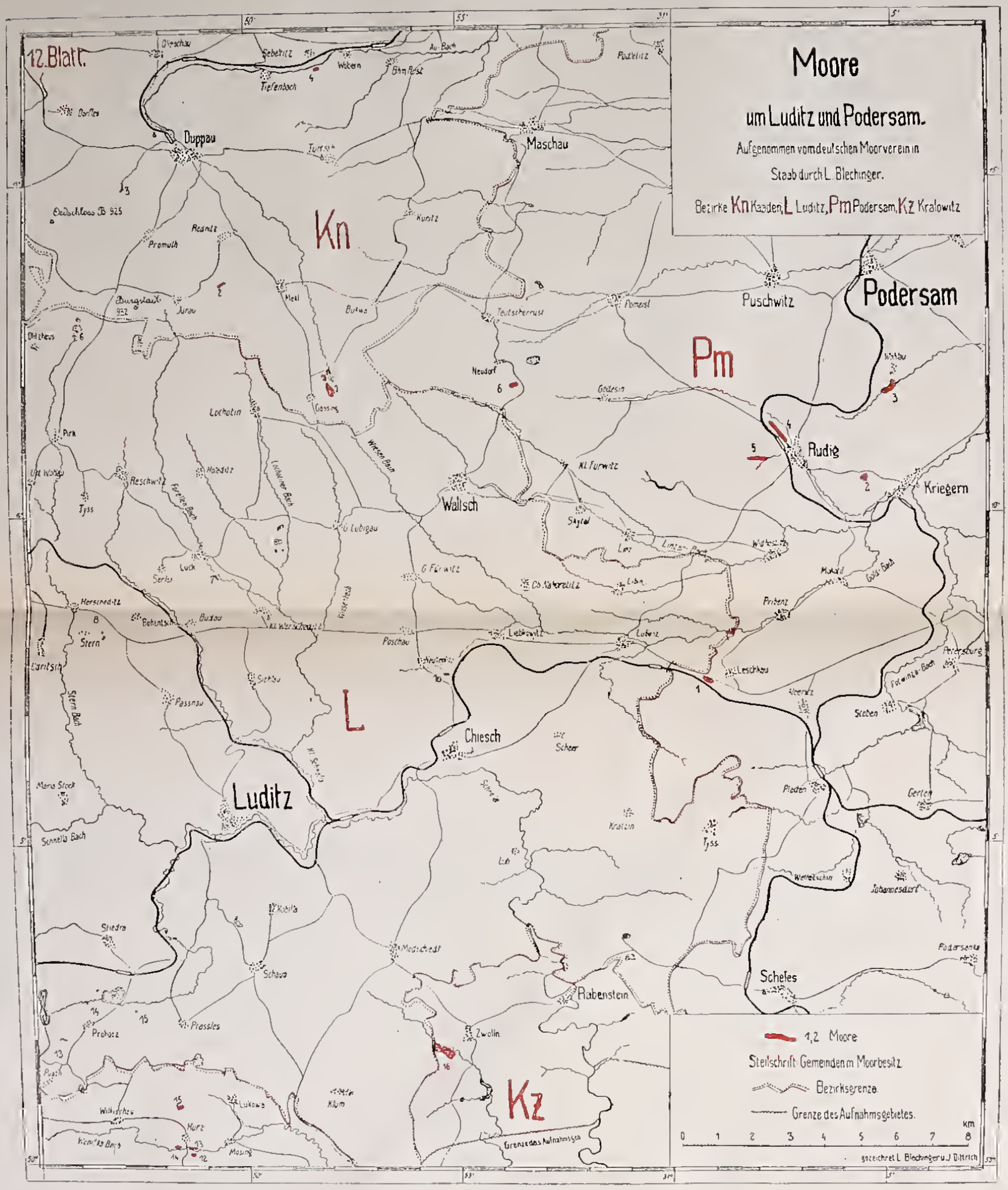
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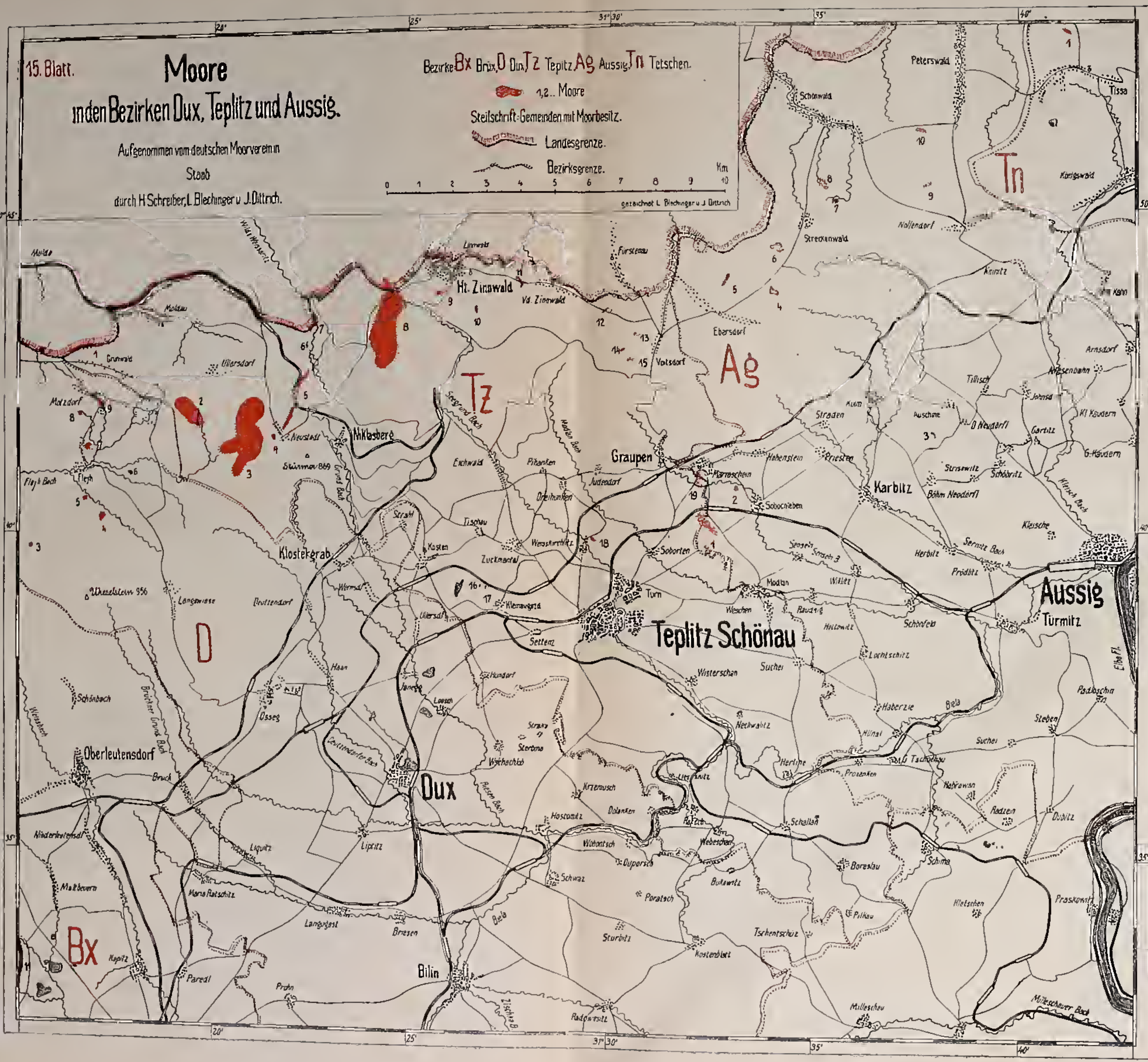
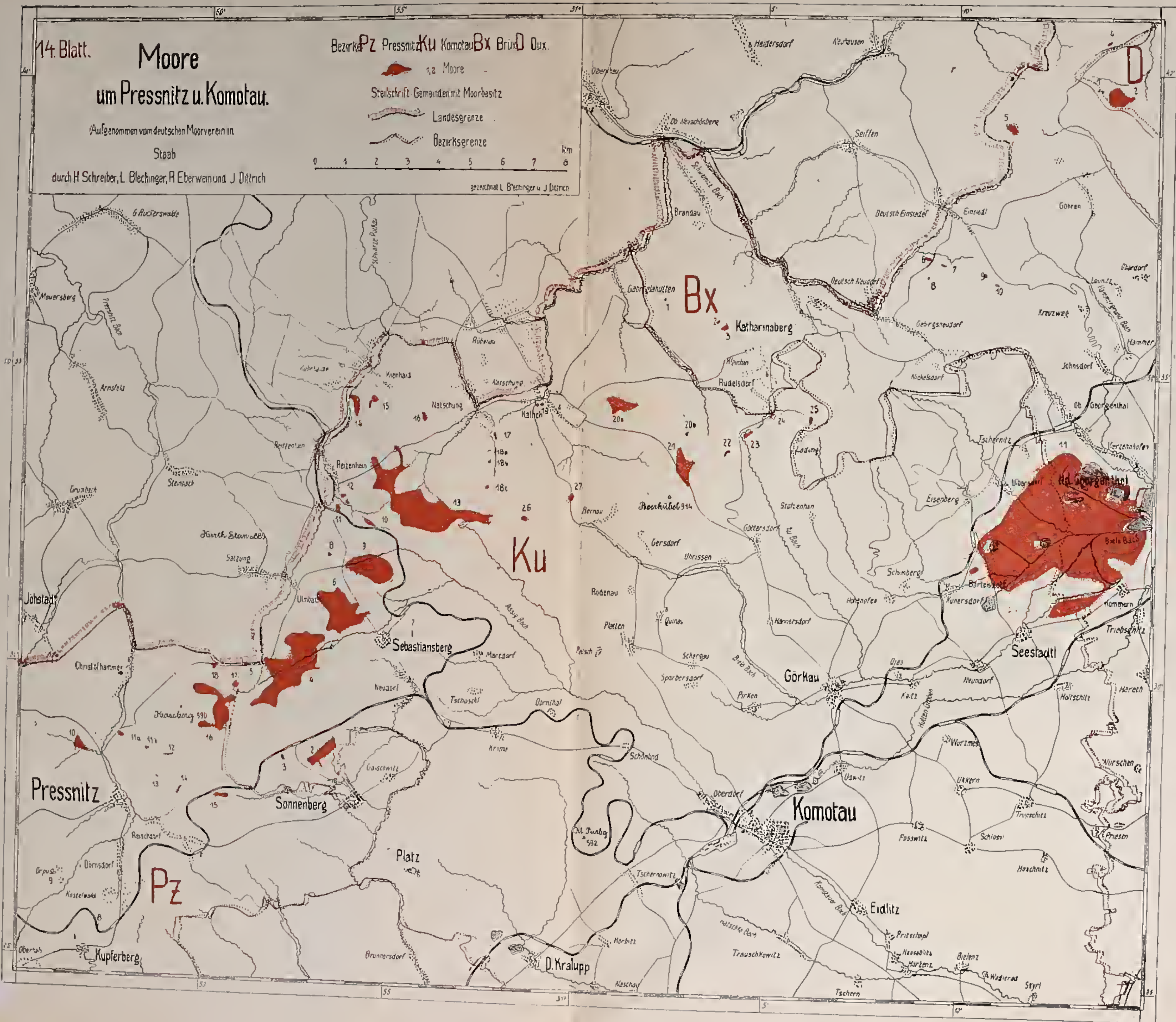
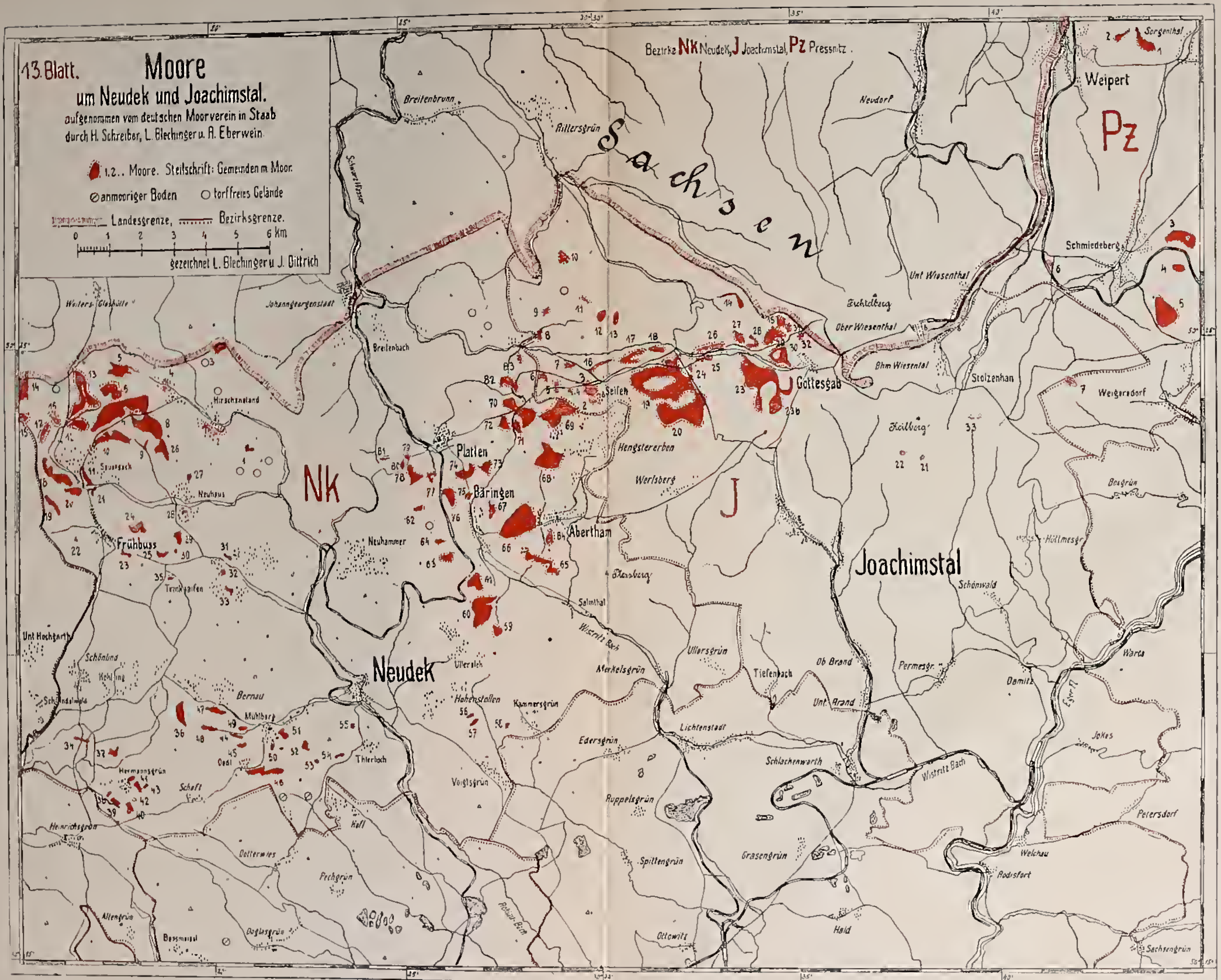
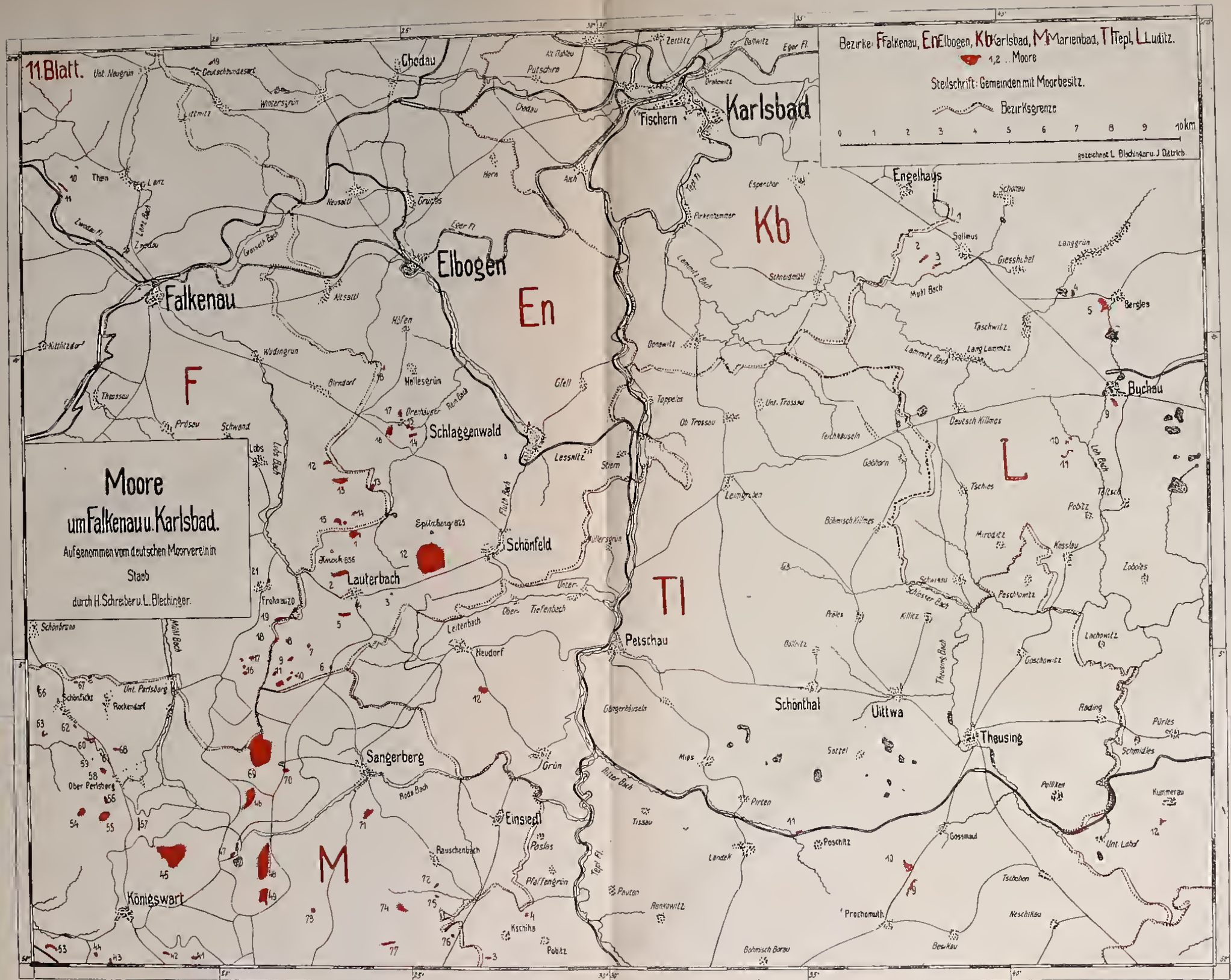
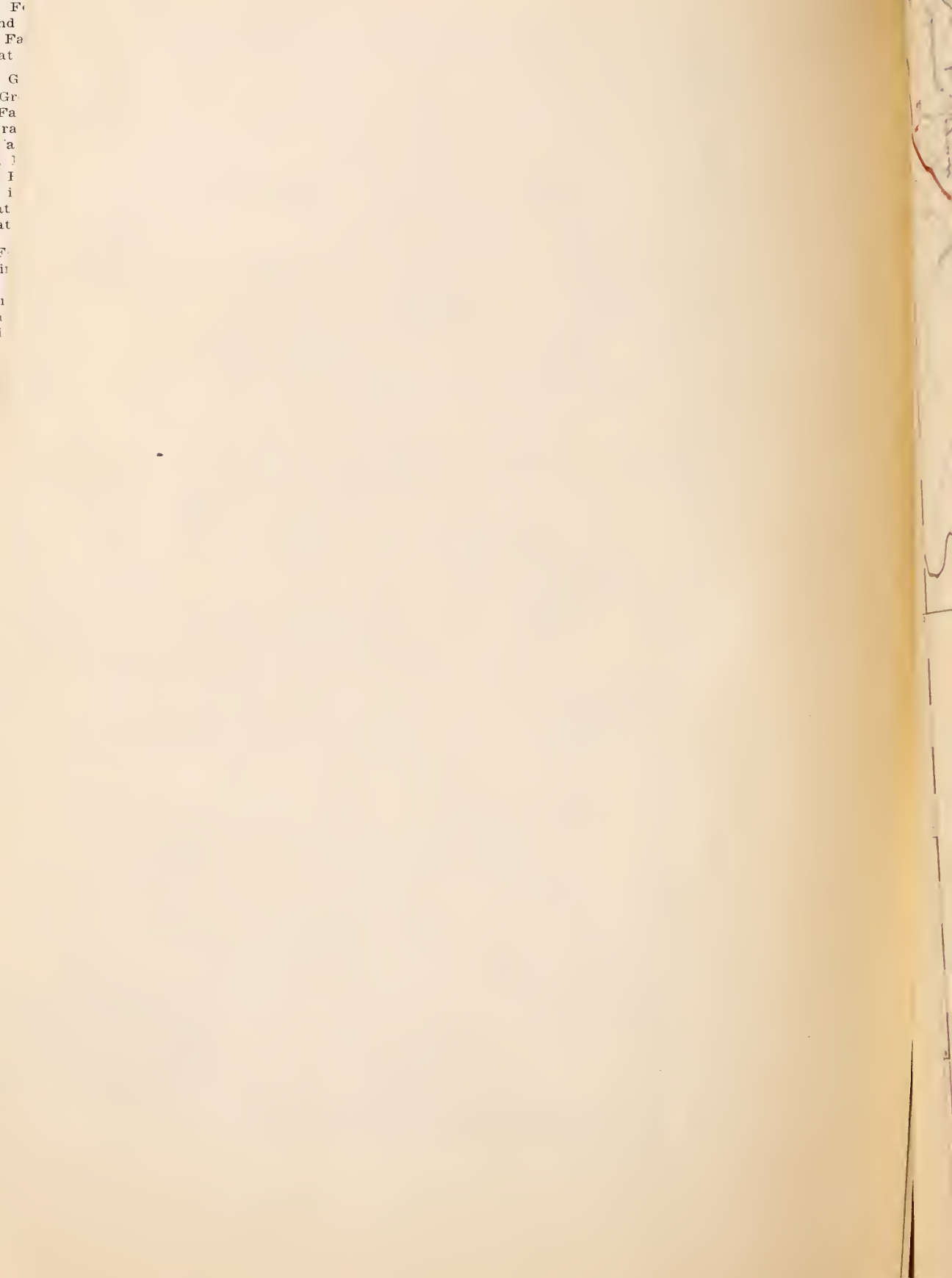
um Luditz und Podersam.
Aufgenommen vom deutschen Moorverein in
Staab durch L. Blechinger.
Bezirke Kn Kaaden, L Luditz, Pm Podersam, Kz Kralowitz
Kn
L
Pm
Kz
Duppau
Maschau
Podersam
Puschwitz
Rudig
Kriegern
Wallsch
Chiesch
Luditz
Scheles
Rabenstein
1,2 Moore
Steilschrift: Gemeinden m Moorbesitz.
Bezirksgrenze.
Grenze des Aufnahmsgebietes.
km
0 1 2 3 4 5 6 7 8
gezeichnet L. Blechinger u. J. Dittrich


15. Blatt.
Moore
in den Bezirken Dux, Teplitz und Aussig.
Aufgenommen vom deutschen Moorverein in
Staab
durch H. Schreiber, L. Blechinger u. J. Dittrich.
Bezirke Bx Brüx, D Dux, Tz Teplitz, Ag Aussig, Tn Tetschen.
1, 2 .. Moore
Steilschrift: Gemeinden mit Moorbesitz.
Landesgrenze.
Bezirksgrenze.
0 1 2 3 4 5 6 7 8 9 10 Km
gezeichnet L. Blechinger u. J. Dittrich
Moore
Teplitz Schönau
Aussig
Dux
Bilin
Graupen
Karbitz
Türmitz
Oberleutensdorf
Klostergrab
Ht. Zinnwald
Nklasberg
Peterswald
Tissa
Ebersdorf
Bx
D
Tz
Ag
Tn


14. Blatt.
Moore
um Pressnitz u. Komotau.
Aufgenommen vom deutschen Moorverein in Staab
durch H. Schreiber, L. Blechinger, R. Eberwein und J. Dittrich
Bezirke Pz Pressnitz Ku Komotau Bx Brüx D Dux.
1,2 Moore
Steilschrift: Gemeinden mit Moorbesitz
Landesgrenze
Bezirksgrenze
0 1 2 3 4 5 6 7 8 km
Pz
Ku
Bx
D
Pressnitz
Sebastiansberg
Sonnenberg
Komotau
Görkau
Seestadtl
Katharinaberg
Eidlitz
D. Kralupp
Kupferberg
Platz
Jöhstadt
Christofhammer
Seiffen
Brandau
Kalkofen
Reitzenhain
Natschung
Ulmbach
Sbasberg
Kommern
Triebschitz
Eisenberg
Oberdorf
Göhren
Johnsdorf
Deutsch Einsiedel
Deutsch Neudorf
Gebirgsneudorf
Hammer
Kreuzweg
Nickelsdorf
Rudelsdorf
Rodenau
Gersdorf
Uhrissen
Pletten
Quinau
Schimberg
Bartelsdorf
Kunersdorf
Neudorf
Hochofen
Holtschitz
Wurzmes
Ukkern
Trupschitz
Fosswitz
Schloss
Priesen
Hoschnitz
Pritschapl
Bielenz
Tschern
Trauschkowitz
Horbitz
Naschau
Brunnersdorf
Tschernowitz
Udwitz
Schönlind
Krima
Görkau
Pirken
Sporbersdorf
Schergau
Neudorf
Tschoschl
Dornthal
Gaischwitz
Reischdorf
Dornsdorf
Orpus
Kostelwald
Oberhals
Satzung
Steinbach
Grumbach
Arnsfeld
Mauersberg
Rübenau
Kienhaid
Kallich
Georgshütten
Bernau
Stolzenhan
Göttersdorf
Ladung
Kieferhausen
Heidersdorf
Ob. Neuschönberg
Schwarze Pockau
Pressnitz Bach
Assig Bach
Biela Bach
Rothenhaus
Ob. Georgenthal
Kl. Purberg 592


13. Blatt.
Moore
um Neudek und Joachimstal.
aufgenommen vom deutschen Moorverein in Staab
durch H. Schreiber, L. Blechinger u. A. Eberwein.
1, 2.. Moore. Steilschrift: Gemeinden m. Moor.
anmooriger Boden
torffreies Gelände
Landesgrenze,
Bezirksgrenze.
0 1 2 3 4 5 6 km
gezeichnet L. Blechinger u. J. Dittrich
Bezirke Nk Neudek, J Joachimstal, Pz Pressnitz.
Sachsen
Nk
J
Pz
Weipert
Schmiedeberg
Gottesgab
Seifen
Platten
Bäringen
Abertham
Frühbuss
Neudek
Joachimstal
Breitenbrunn
Breitenbach
Neuhammer
Hengstererben
Werlsberg
Stolzenhan
Weigersdorf
Unt Wiesenthal
Ober Wiesenthal
Bhm Wiesental
Hirschenstand
Neuhaus
Trinksaifen
Salmthal
Merkelsgrün
Ullersgrün
Tiefenbach
Ob Brand
Unt Brand
Lichtenstadt
Schlackenwerth
Edersgrün
Ruppelsgrün
Spittengrün
Grasengrün
Hohenstollen
Kammersgrün
Bernau
Mühlberg
Thierbach
Voigtsgrün
Hermannsgrün
Schaft
Heinrichsgrün
Dotterwies
Pechgrün
Permesgr.
Schönwald
Dömitz
Jokes
Warta
Welchau
Rodisfort
Petersdorf
Hald
Ottowitz
Sachsengrün
Wistritz Bach
Unt Hochgarth
Schönlind
Kohling
Weiters Glashütte
Johanngeorgenstadt
Rittersgrün
Neudorf
Sorgenthal
Keilberg
Hüttmesgr.
Bergrün


11. Blatt.
Bezirke: F Falkenau, En Elbogen, Kb Karlsbad, M Marienbad, T Tepl, L Luditz.
1,2 .. Moore
Stellschrift: Gemeinden mit Moorbesitz.
Bezirksgrenze
0 1 2 3 4 5 6 7 8 9 10 km
gezeichnet L. Blechinger u. J. Dittrich.
Moore
um Falkenau u. Karlsbad.
Aufgenommen vom deutschen Moorverein in
Staab
durch H. Schreiber u. L. Blechinger.
Falkenau
Elbogen
Karlsbad
Chodau
Tischern
Engelhaus
Buchau
Bergles
Schlaggenwald
Schönfeld
Lauterbach
Petschau
Schönthal
Uittwa
Thausing
Sangerberg
Einsiedl
Neudorf
Königswart
Poschitz
Prochomuth
Besikau
F
En
Kb
L
Tl
M




10. Blatt.
Moore
um Asch, Eger und Graslitz.
Bezirksgrenze.
0 1 2 3 4 5 6 Km
gezeichnet L. Blechinger u. J. Dittrich.
Woadreb
Alt-Kinsberg
Cosel
Alt-Albenreuth
Taubrath
Palitz
Schwaderbach
Unt. Sandau
Zeidlweid
Ober-Sandau
27
28
29
30
21
20
24
22
23
51
50

10. Blatt.

Moore

um Asch, Eger und Graslitz.

Aufgenommen vom deutschen Moorverein in
Staab
durch L. Blechinger u. H. Schreiber.

Sachsen

Bezirke A Asch E Eger F Falkenau G Graslitz M Marienbad.

1, 2 .. Moore

Steilschrift: Gemeinden mit Moorbesitz.

Landesgrenze.

Bezirksgrenze.

0 1 2 3 4 5 6 Km

gezeichnet L. Blechinger u. J. Dittrich

7. Blatt.

Bezirke: TuTachau, BiBischofteinitz, TTaus

Moore

um Haid und Ronsperg

Aufgenommen vom deutschen Moorverein in Staab
durch L. Blechinger, H. Schreiber u. J. Dittrich

Grenze des Aufnahmsgebietes.

1, 2 ... Moore. Steilschrift: Gemeinden mit Moorbesitz.

anmooriger Boden — torffreies Gelände

Landesgrenze — Bezirksgrenze

0 1 2 3 4 5 6 Km

gezeichnet L. Blechinger u. J. Dittrich.

Tu

Bi

T

U

8. Blatt.

Bezirke M Marienbad, Pn Plan, Tu Tachau, Tl Tepl

Moore

um Marienbad, Plan, Tachau.

Aufgenommen vom deutschen Moorverein

in Staab

durch L. Blechinger, H. Schreiber u. J. Dittrich

Moore

Steilschrift: Gemeinden mit Moorbesitz

anmooriger Boden

torffreies Gelände

Landesgrenze

Bezirksgrenze

0 1 2 3 4 5 6km

Gezeichnet L. Blechinger u. J. Dittrich

Marienbad

Plan

Tachau

M

Pn

Tu

Tl

Neu Albenreuth

Ullrichsgrün

Maiersgrün

Grafengrün

Altwasser

Tannawa

Veumetternich

Gr Siehdichfür

Kl Siehdichf.

Dreihacken

Tachauer Schmeltztal

Lohhäuser

Ourrmaut

Kuttenplaner Schmeltztal

Oberdorf

Neudorf

Prommenhof

Hinterkotten

Rojau

Lusading

Hurschk

Ober Gramling

Abaschin

Hohendorf

Müllestau

Auschowitz

Habakladrau

Stanowitz

Wischetzahn

Kuttnau

Pistau

Punau

Kuttenplan

Michelsberg

Heiligenkreuz

Brand

Stockau

Pirkau

Strebenreith

Wittingreith

Zetlisch

Ottenreuth

Damnau

Tissa

Elhotten

Ostrau

Bernetzried

Schönbrunn

Albersdorf

Schönwald

Hals

Galtenhof

Angelberg

Thiersarten

Sorghof

Brand

Paulusbrunn

Barnau


9. Blatt.
Moore
in den Bezirken Tepl, Plan u. Kralowitz.
Aufgenommen vom deutschen Moorverein in
Staab
durch H. Schreiber u. L. Blechinger
Tepl
Tl
Pn
Kz
Neumarkt
Weseritz
Leskau
Tschernoschin
Mies
Netschetin
Bezirke Tl Tepl, Pn Plan, Kz Kralowitz
1, 2 .. Moore.
Steilschrift: Gemeinden mit Moorbesitz.
Bezirksgrenze
0 1 2 3 4 5 6 7 8 km
gezeichnet L. Blechinger u. J. Ditlrich